FACTORS ASSOCIATED WITH SELECTION OF AND PERSISTENCE IN CHEMISTRY AS AN AREA OF SPECIALIZATION BY OKLAHOMA STATE UNIVERSITY UNDERGRADUATES

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CHAPTER I

THE PROBLEM

This study was concerned with the problem of identifying factors associated with selection of and persistence in chemistry as an area of specialization by college undergraduates. The problem is one of several connected with the growing shortage in the United States of physical scientists, engineers, and teachers in these fields. Much has been written and said about the causes of and possible solutions to this increasing shortage. Steps have been taken by various individuals and groups in the hope that the trend might be reversed.

In the field of chemistry the downward trend in percentages of chemistry majors is apparent. During the academic year 1947-48, chemistry majors in the United States accounted for 2.72% of all bachelor's degrees conferred. This percentage dropped the next year to 2.49%, then successively to 2.46%, 2.15%, 2.05%, 1.95% and 1.98% in 1953-54.[1] A similar and perhaps more pronounced situation was found at The Oklahoma State University of Agriculture and Applied Science. (Prior to the summer of 1957, the name of the institution was The Oklahoma Agricultural and Mechanical College.) Beginning with the year 1943-44, 2.09% of the students in the senior class were majoring in chemistry. This percentage changed the next year to 1.03%, then successively to 0.88%, 1.84%, 1.00%,

[1] B. R. Stanerson, "High School Chemistry Teaching," Chemical and Engineering News, XXXIII (1955), 1213-1216.

1.58%, 1.30%, 0.67%, 0.73%, 0.57% and 0.27% in 1953-54. There were some fluctuations, but the general trend has been downward. Also, it can be seen that the percentages were lower than the national figures.

During the past twelve years at The Oklahoma State University of Agriculture and Applied Science, the number of students who selected chemistry as a major but changed to a different field before graduating has been approximately equal to the number who selected chemistry as an area of specialization and persisted. Hence, if those who did not persist had stayed with chemistry, the percentages of chemistry majors would have been about twice what they were. At the same time, there were many students who took at least one course in chemistry before they declared a major. If they could have been so attracted to chemistry that they would have selected it as a major and graduated with a degree in chemistry, the percentages would have been three or four times what they actually were. If similar increases in percentage of chemistry majors could have been realized by all other colleges in the United States, probably there would not now be such a critical shortage of chemists.

Several factors which may be associated with selection of and persistence in chemistry as an area of specialization by undergraduates have been cited in the literature and voiced before various audiences. Each person writing or speaking usually has given from one to three factors which he apparently has believed are the summa summarum associated with the problem. But when all of these <u>one's</u>, <u>two's</u>, or <u>three's</u> are added together, the list appears stupendous and confusing. One begins to wonder whether or not the factors listed are supported by evidence. Which of these exert the most influence? Which have no influence at all? As lengthy as this list is, are there still other factors, perhaps more important, which have not found their way into an article or speech?

Statement of the Problem

This study, therefore, is concerned with the problem: What factors are associated with the selection of and persistence in chemistry as an area of specialization on the part of undergraduate students at The Oklahoma State University of Agriculture and Applied Science?

The Need for the Present Study

There is urgent need for this study. Scientific personnel second to none in quantity and quality are essential for maintaining the American way of life. Recently Senator Hubert Humphrey in a letter to President Eisenhower urging him to establish a special commission to study the shortage of scientists and engineers stated:

> Not enough scientists and engineers are being trained each year to meet our national requirements. As a result, the research and development programs of our industries and armed forces have been curtailed. The shortage of research scientists, especially, is not only one of quantity but also of quality.[2]

The percentage of chemistry majors has declined while the need for chemists has increased. It is time to get at the root of the problem. The situation at Oklahoma State University appears to be as critical as, or more critical than, that for the country as a whole. The results obtained and the pattern of study followed here may serve as a guide for students at other colleges which have this same problem. Information that can be obtained should be of value in helping to reverse the trend of decreasing percentage of chemistry majors.

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[2]Hubert Humphrey. "Scientific Manpower," Chemical and Engineering News, XXXIII (1955), 5161.

Basic Hypothesis

The hypothesis basic to this study was that there are identifiable factors associated with selection of and persistence in chemistry as an area of specialization by college undergraduates.

Basic Assumptions

In the following paragraphs three assumptions which were basic to this research are stated.

The literature is replete with speculations on causes for a shortage of scientific personnel. Although causes for a shortage of chemists would be difficult to establish, it seems safe to assume that there are factors associated with selection of and persistence in chemistry as an area of specialization on the part of undergraduates in higher education.

Obviously the people intimately associated with the instruction of undergraduates in chemistry have opinions about what the factors are. It therefore seems safe to assume that the factors can be identified by consensus of those people, students, instructors and others, who are intimately associated with undergraduate instruction in chemistry.

Furthermore, since Oklahoma State University is one of the land grant colleges, it seems safe to assume that factors generally associated with the selection of and persistence in chemistry as an area of specialization by undergraduates in land grant colleges correspond with those derived from information obtained from undergraduate students at Oklahoma State University.

Purposes of the Study

The first purpose of the study was to identify those factors or patterns of factors which are associated with the selection of chemistry as a major by undergraduates at Oklahoma State University.

The second purpose of the study was to identify those factors or patterns of factors which are associated with persistence in chemistry as a major by undergraduates of Oklahoma State University.

The third purpose of the study was to design a procedure which would result in the actual identification of the factors.

Scope of the Study

This study was concerned only with the identification of factors associated with selection of and persistence in chemistry as a major. It did not include research to establish the best solution to the shortage of chemists. However, recommendations which might improve the situation were given.

Included in the study were certain students currently enrolled at Oklahoma State University who enrolled in the College of Arts and Sciences one or more times during the years 1952-53 to 1955-56, inclusive. While there they either selected chemistry as a major or, before choosing a major, elected to take one or more courses in chemistry, but then selected some area other than chemistry for specialization.

Certain graduates of Oklahoma State University for the years 1952-53 to 1955-56, inclusive, were also included in the study. Those graduates who were enrolled in the College of Arts and Sciences when they stated in writing that their major was chemistry were included. Also included were those in the College of Arts and Sciences who elected to take one or more courses in chemistry before choosing a major, but then selected some field other than chemistry for specialization.

Sources of Data

The data for this study were obtained from the following sources:

1. Directories of advisees for the years 1948-49 to 1955-56, inclusive, in offices of the dean of the College of Arts and Sciences. These lists gave the names of all students enrolled in Arts and Sciences, their majors (if selected), American Council on Education Psychological Examination for College Freshmen (A.C.E.) scores (if examination had been taken), the students' classifications, and their college addresses at the time of enrollment.
2. Students' record folders in the College of Arts and Sciences offices. These included general information sheets, personal inventories, biographical data sheets, copies of enrollment cards, upper-division examination records, plans of study for upper division, letters of communication, themes: "Factors in My Past Experience" and "Vocational and Educational Objectives," Kuder preference profile sheets, adjustment inventories, conference memoranda, and news clippings. Some student folders had all these data, some only a small part of them.
3. The records of the same students in the registrar's office. These included courses taken at Oklahoma State University and grades made, degrees conferred, majors and minors selected, high school subjects taken, records of courses had at other colleges, home addresses, ages, sex, persistence in college, and years of enrollment.
4. Educational literature dealing with factors pertaining to the problem.
5. Judgment of qualified educators in land grant colleges recorded on a rating scale consisting of opinions obtained from students and faculty and from the literature about factors associated with selection of and persistence in chemistry.

6. Personal interviews with three groups of students enrolled at Oklahoma State University during the second semester of the school year 1955-56. One group included all students who declared chemistry as their major. Another consisted of all students who once had declared chemistry as their major but changed to some other area of specialization. A third group included all students who elected to take one or more courses in chemistry before declaring a major, then chose some field other than chemistry as an area of specialization.

7. A rating scale, consisting of forty-five items derived from the replies of land grant college educators, and answered by three groups of students who graduated from Oklahoma State University during the period 1953 to the first semester of 1956, inclusive. The groups included students who received bachelor's degrees in chemistry, those who once had declared chemistry as their major but received bachelor's degrees in some other area of specialization, and students who took one or more courses in chemistry before declaring a major and then received bachelor's degrees in fields other than chemistry.

8. Free responses of the same groups of graduates as to why they did or did not select chemistry as a major and why they did or did not persist in it if they selected it as a major.

Definitions of Terms

Definitions for terms as used in this study are as follows:

<u>Chemistry major</u> is defined as a student in the College of Arts and Sciences who has declared in writing that he has selected chemistry as his area of specialization.

<u>Persistence</u> for currently enrolled students is defined as having listed

chemistry as a major at least twice; for graduates it is defined as having received a bachelor's degree with a major in chemistry.

Factor is defined as one of the circumstances or influences that contribute to selection of or persistence in chemistry as an area of specialization by college undergraduates.

Elected, as used in the expression "elected to take one of more courses in chemistry," is defined as chosen by the student before he had declared in writing what his major was.

Organization of the Study

Chapter I is an introduction to the study. In it the problem is stated. The need for the study, basic hypothesis, basic assumptions, purposes of the study, scope of the study, sources of data, definitions of terms, and the organization of the study are given. In chapter II the background and needs for the study are considered in more detail. In chapter III the general structure of the procedure and the manner of selecting the population for the study are given. Chapter IV is a continuation of procedure in which the rating scales and interview are considered. Results are summarized in Chapter V. Conclusions and recommendations are reported in Chapter VI.

CHAPTER II

BACKGROUND AND NEEDS FOR THE STUDY

Immediately following World War II, "trend-spotters" warned that Russia would soon surpass the United States in training scientists and engineers.[1] As years went by, greater numbers realized that a serious problem existed in the lack of sufficient scientific manpower. However, in the latter part of 1954, a federal government group, called the Cabinet Committee, proposed a long-range rather than a "crash" program for correcting the situation since at that time there were not enough facts available concerning the reasons and extent of the shortage of scientific manpower.[2]

Later, Congressman Carl Hinshaw introduced a bill to channel scientists eligible for military service into defense laboratories instead of into army mess halls as "potato peelers." This bill was bitterly opposed by Selective Service Director Lewis B. Hershey on the grounds that it was an "escapist plan." Hershey further added that American experts had never advised him how many young scientists or engineers should be deferred. Hinshaw retorted that Hershey's agency was largely responsible for the

[1]"It's Confirmed . . .," Chemical and Engineering News, XXXIII (1955), 5160-5161.

[2]"Science Training Rests on Public," Chemical and Engineering News, XXXII (1954), 5055.

shortage of scientists and engineers.[3] However, many "experts" in high places and low have pointed in other directions and said, "There is the trouble. This is what we ought to do about it."

As anxiety has mounted in later years over anticipated and more severe manpower shortages and over the ease with which Russia turns out science graduates, the American home, the general public and government, the elementary school, the secondary school, and the college have been censured as sources of the shortage.

The Home

Some people have claimed that a few factors related to the problem have originated in the home. For instance, Union College at Schenectady, New York, sponsored group meetings which were attended by college chemistry staff members, high school chemistry teachers and guidance counselors, junior high school science teachers, and chemists. One point agreed upon was that students are less willing to work as hard as they did formerly. "The home environment was blamed for not being able, in many cases, to inculcate in the present younger generation a spirit of willingness to work. They suggested that all parents examine themselves critically."[4] Perhaps this suggestion was made because parents, as a group, were not represented in the meeting.

Another criticism that has been directed toward the home is that not enough parents have encouraged their children to pursue the study of chemistry. An example of what can happen when such encouragement is

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[3]"Hope for Ph.D. Potato Peelers?," Chemical and Engineering News, XXXIII (1955), 608.

[4]Charles B. Hurd, "How Can More Students Be Encouraged to Study Chemistry As a Profession?," Journal of Chemical Education, XXXIII (1956), 132-134.

given was found in a group of eight high school boys who recently received national recognition for organizing a chemistry club, developing a rapidly-expanding library, and working out some worth-while objectives. All members of the club had their own home laboratories. Most of the boys became interested in chemistry about the age of six. The interest of most of the boys was traced to a gift of a toy chemistry set. As one boy explained it, his mother got so fed up with his messing around with her kitchen spices and doing other experiments with ground-up pencils and the family toiletries that she decided it would be cheaper, and possibly more constructive, to buy him a chemistry set.[5]

The Public and Government

Perhaps the public and government have been remiss. It would appear so from the recommendation offered by James R. Killian, Jr., President of Massachusetts Institute of Technology. He stated,

> "We must marshal public opinion to de-emphasize the hot-rodders among our youth and to encourage hot mathematicians. . . . The nation should establish several thousand more scholarships to help gifted but needy high school graduates go to college. . . . I advocate that we start now by establishing 9,000 competitive, annually awarded, four-year federal scholarships. . . . We need to encourage more able women to major in science and mathematics."[6]

Also, from the following report, the Manufacturing Chemists' Association evidently believes that the general public has not done all that it could to aid science education.

> The Manufacturing Chemists' Association is now considering a long-range program for member companies' use in their own plant communities. The program under consideration is an off-shoot of results of the recent White House Education Conference in which Manufacturing Chemists'

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[5]"Chemistry Among the Teen-age Set," Chemical and Engineering News, XXXIV (1956), 354-355.

[6]James R. Killian, Jr., "A Bold Strategy to Beat Shortage," Life, May 7, 1956, p. 147.

Association played a part. . . . The idea is that neither the states nor the Federal Government can be depended on solely to deal with the education crisis. The brightest promise is at the local level. . . . Local chemical industry leaders would go to the superintendents of schools or other appropriate local education officials at the junior and senior high school levels and offer them aid with their science and education problems.[7]

Dr. Oliver S. Willham, President of Oklahoma State University, has blamed the citizenry for students' weakness in the field of science. He wrote:

Today we hear criticisms made of our secondary schools. Too many students come to college not adequately prepared in basic mathematics and science courses. This is not the fault of our high schools and other administration. It is our fault as citizens. Our school administrators will provide the training we want our boys and girls to have if we ask them and pay for it. The type of training we want in mathematics and science for our high schools costs more money than we have been willing to furnish.[8]

The Elementary School

Some people have expressed the opinion that choice of a scientific career begins in the elementary school. Therefore, they have said that elementary school teachers should be better trained in science and mathematics. In addition, they have declared that more science and mathematics should be taught in the grades and that more and better equipment for teaching science in elementary schools should be obtained. They have called attention to crowded conditions in schools and have suggested that size of classes be reduced.

Some have advocated the early selection and encouragement of children with scientific talent.

Frank Auld, Jr., assistant professor of psychology at Yale, said that

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[7]"Aid on the Community Level," Chemical and Engineering News, XXXIV (1956), 468.

[8]The Daily O'Collegian, February 7, 1957, p. 1.

psychological testing of school children would reveal talented youngsters who could than be encouraged to obtain the educational background that would qualify them for scientific careers. He maintained that these tests should be given in the eighth or ninth grades at the latest "And it would be even better if they were given in the fifth or sixth grade."[9]

Henry Chauncey, President of Education Testing Service, was also of the opinion that the testing program to discover talent should begin in the fifth or sixth grade or sooner and must begin no later than the eighth or ninth grade.[10]

John T. Rettaliata, president of Illinois Institute of Technology, has said that search for scientific talent should start in the higher elementary grades and that students should be convinced that science and mathematics are not unduly difficult.[11]

The United States Commissioner of Education, Samuel M. Brownell, speaking before the National Science Teachers' Association in Washington, D. C., on March 16, 1956, said,

"I want to give you my assurances . . . that the United States Office of Education is cooperating with many individuals and groups . . . toward a solution to what has become known as the "science shortage". . . . The solution to the problem of scientific manpower . . . involves the preparation of elementary school teachers who can gain and sustain interest of children in quantitative thinking and concern of natural phenomena so that when they reach the secondary school their interest in mathematics and science has been increased - not diminished - by elementary school experience."[12]

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[9]"Building Engineers from Scratch," Chemical and Engineering News, XXXIII (1955), 3088.

[10]Henry Chauncey, "New Approaches to Old Problems: Teacher Shortage in Science and Mathematics," California Journal of Secondary Education, XXX (1955), 257-262.

[11]John T. Rettaliata, "The Scientific Manpower Shortage - A Peril to America," School and Society, July 23, 1955, p. 17.

[12]Samuel M. Brownell, "Tackling the Manpower Shortage," School Life, May 1956, p. 5.

The Secondary School

Voices from all sections of the United States have echoed and re-echoed that the secondary schools do not teach enough science and mathematics. What is taught has been described as inferior in quality for the most part. High school teachers are poorly-trained. No effort has been made to recognize the gifted student. Little encouragement has been given those who might develop into scientists if they had the chance.

Samuel S. Kistler, Dean of the College of Engineering at the University of Utah, wrote:

> Secondary schools must reassume their function as preparatory schools for the gifted young people who are destined to go on to college. . . . So much more can be done in high school toward stimulating young people to prepare for careers in college that the high school really becomes the key to the solution of our technical manpower problem.[13]

High School Teachers

There are those who have claimed that college enrollment in chemistry is not at a higher level because of the need for more well-qualified and inspiring chemistry teachers in secondary schools. For example, W. Conard Fernelius, Chairman of the Department of Chemistry at Pennsylvania State College, wrote: "One of the most significant factors contributing to the decrease in the number of college students training in chemistry is the lack of enthusiastic, competent teachers in the secondary schools of this country."[14]

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[13] Samuel S. Kistler, "Improving the Quality of Graduate Engineers Concomitant with Increasing Registrations," College of Education Record, January 1956, p. 27.

[14] W. Conard Fernelius, "More Competent Science Teachers Needed in Secondary Schools," The Vapor Pressure, XXV (1955), p. 58.

Likewise, during an address in which he accepted the Industrial Research Institute Medal for 1955, Ernest H. Volwiler, president of Abbott Laboratories, stated, "Our high school teachers are inadequate in numbers and training . . . many of our high school teachers have had considerable training in how to teach but little training in what they are teaching."[15]

Furthermore, Robert E. Wilson, chairman of the board, Standard Oil Company, speaking at a national meeting of the American Chemical Society said,

"At school, our potential scientist is likely to have his chemistry presented by a teacher who has spent more time learning how to teach than what to teach. Such teachers are seldom able to fire the imagination. . . As a result, many high school graduates enter college with neither the necessary prerequisites nor a vivid interest in science. . . . Waste in our secondary school system also arises from the failure to encourage and speed along the really superior minds."[16]

Moreover, Samuel Schenberg, Supervisor of Science, Board of Education of the City of New York, has stated that the limiting factor in the production of trained scientific manpower is the high school teacher. During the academic year 1955 in the city of New York, 470 classes containing approximately 15,700 students were taught science by teachers who did not possess a science license.[17]

Furthermore, in 1955 J. C. Warner, president-elect of the American Chemical Society, said,

"The key to solving the critical shortage of scientists and engineers

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[15]"Teachers Lack Subject Knowledge," Chemical and Engineering News, XXXIII (1955), 2620.

[16]Robert E. Wilson, "Maintaining the Pace of Scientific Development," Chemical and Engineering News, XXXIII (1955), 1664-1669.

[17]"Missing: High School Teachers," Chemical and Engineering News, XXXIII (1955), 4528.

lies in greater numbers and more competent teachers of science and mathematics in our secondary schools. . . . It is in the secondary schools that gifted students must be identified as potential scientists and inspired to enter science as a career. . . . Too many students arrive at college with neither the preparation nor the proper motivation for going ahead with science. Too many are exposed to fuzzy courses in general science and the marvels of science without receiving a disciplined introduction to the laws of nature or to scientific methods."[18]

In addition, Glenn Seaborg of the University of California, after reflecting on his high school experiences, said,

"I'm not as worried as some about the lack of education per se - most scientists overcome that somehow - but the thing we can't overcome is the loss of the man to science because he has a teacher who has no interest in it, and fails to bring him into the fold, so to speak. I know, in my case, the influence of a high school teacher was particularly decisive, and this is the case with a number of my friends, too."[19]

The National Science Foundation granted more than a million dollars in 1956 for summer institutes and full-year programs designed to improve the quality of high school teaching in science and mathematics. C. H. Sorum, director of the full-year program at the University of Wisconsin, pointed out that

Well-trained scientists, in far greater number than our colleges and universities are now turning out, are needed if the growing scientific manpower requirements of technology and research are to be met. The future scientists are to be recruited from the ranks of high school students. If they are to be recruited, they must first be introduced to science, must be inspired to seek a career in science, and must be taught the rudiments of science. This inspiration, teaching, and recruitment must come, largely, from our high school teachers; and if they are to do the kind of job that needs to be done, there must be more of them, and they must be capable and well-trained.[20]

Until recently, the National Academy of Sciences-National Research Council had been concerned only with educational matters beyond the

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[18]"Turning Students Into Scientists," Chemical and Engineering News, XXXIII (1955), 5162.

[19]"Cries for the Well-Trained," Chemical and Engineering News, XXXIV (1956), 31.

[20]"A Million for Teachers," Chemical and Engineering News, XXXIV (1956), 572.

post-doctorate level. Lately, the council has become interested in high school science education. It has begun a program to provide paid schooling for high school science teachers in Arlington, Virginia. Furthermore, it has started a program to place these teachers in summer jobs which contribute to their professional background. All this is an indication of how seriously the National Academy of Sciences-National Research Council viewed the scientific manpower shortage. The council believed that the wide background knowledge gained by these secondary teachers would be passed on to their students in a stimulating and interesting manner. It hoped that new interest in science on the part of high school students would be created.[21]

Industry has become more aware that it must help keep good high school science teachers in the classroom by supplementing the teachers' salaries. In 1953 a survey conducted by John H. Woodburn of the Future Scientists of America Foundation showed that one-sixth of a selected group of companies made a special effort to hire high school science teachers for summer jobs. One-fourth of these companies did so in 1954, and one-third of them in 1955. Some industries have realized that the high school science teacher problem is a serious one which will ultimately affect them.[22]

High School Program

Some people have claimed that college enrollment in chemistry is not at a higher level because certain aspects of the high school program

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[21] "New Hope for Science Teachers," Chemical and Engineering News, XXXIII (1955), 4818.

[22] "Upswing in Summer Jobs," Chemical and Engineering News, XXXIII (1955), 4936.

need to be improved. For example, Otto M. Smith, the 1956 winner of the Scientific Apparatus Makers' Association award in chemical education, expressed the opinion that inadequate and sometimes complete absence of science laboratories in the nation's high schools may well be the cause for declining student enrollment in the sciences. "If science," said he, "is to be a real flesh and blood everyday experience, students should actually have opportunities for working in laboratories where they can see for themselves and feel, smell, taste, and undergo the experiences of their predecessors."[23]

Likewise, Robert H. Carleton, executive secretary of the National Science Teachers' Association, has spent a great deal of time observing science teaching in high schools throughout the country. He has noted that many American high school administrators and boards of education permit science to be taught by demonstration methods rather than by individual laboratory work. Worse yet, in many schools there is not adequate equipment; in others there is no provision for laboratories of any sort. Said he, "When the laboratory and its emphasis on the investigative or research-type exercise disappears from day-in, day-out science teaching, then the heart and chief inspiration of science as a form of human endeavor have been lost."[24]

Furthermore, H. H. Bliss, University of Oklahoma chemistry professor, made a study of chemistry offerings in the high schools of Oklahoma for the year 1953-54. In a sample of 351 schools he found that seventy-one

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[23]"Labs Beget Scientists," Chemical and Engineering News, XXXIII (1955), 4072.

[24]"Defrauding Scientists," Chemical and Engineering News, XXXIII (1955), 5042.

offered chemistry that year. Out of 10,000 students enrolled in science courses where chemistry was offered, only fifteen per cent in schools with enrollment over 500 were taking chemistry, whereas 44.6 per cent in schools under 201 enrollment were taking chemistry. He concluded that recruiting and guidance efforts now directed toward urbanized youth might be more fruitful if directed toward the youth of semi-rural communities who might respond to the challenge of a scientific career in chemistry in sufficient numbers to provide the much-needed supply of technical manpower.[25]

Charles Allen Thomas, president of Monsanto Chemical Company and past president of the American Chemical Society, speaking to the 128th meeting of the American Chemical Society said,

"The number of subjects in our high schools has mushroomed from nine in 1890 to 274 at the present time. Whatever the reason, our secondary school has become a sort of educational cafeteria offering a bewildering assortment of studies. There's no doubt about it, chemistry, physics, and algebra are more difficult than family relations or personal hygiene - so why bother? Since they all lead to the same goal - the diploma - why not take the course of least resistance? . . . Most disturbing is the tragic waste of talent among the gifted students who succumb to the temptation to choose the softest subjects."[26]

Moreover, Clifford F. Rassweiler, vice-chairman of the board, Johns-Manville Corporation, has said the root of the trouble in the technical manpower situation lies in the long-range changes in high school program. There has been a tendency for students to avoid mathematics and science courses and to take up "snap" courses in which it is possible to attain higher grades with less effort. This practice, he said, helps students

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[25]H. H. Bliss, "Secondary-School Chemistry Offerings in Oklahoma," Journal of Chemical Education, XXXII (1955), 428-430.

[26]"Science Suffers From Anemia," Chemical and Engineering News, XXXIII (1955), 3928.

to get scholarships to college.[27]

Opinions of High School Students

Opinionnaires answered by high school students about science have made news. One which received wide publicity was made by Melvin Barnes, assistant superintendent of Oklahoma City schools. He asked a number of high school juniors the question, "Why is it more students do not take science and mathematics?" Some of the typical replies follow:

"Einstein! Long hair and a sweat-shirt."

"A scientist is an evil genius on TV thinking up ways to torture people."

"Scientists are squares - little old men with beards working in a musty laboratory."

"Scientists work alone and are not very sociable."

"Science and math courses are dull, and they take too much time."[28]

An opinionnaire study of one hundred junior and senior students of the Shortridge High School, Indianapolis, by Henrietta A. Parker, physical science department, was made after the Oklahoma City survey was publicized. Almost exactly opposite opinions were expressed. They did not consider scientists as "squares" or "long hairs." They did not think mathematics courses were dull. Most of them considered science a worthy and interesting career.[29]

Following these two studies, a survey including 15,000 high school

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[27]"No Spurs to Study Science," Chemical and Engineering News, XXXIII (1955), 2823.

[28]"Squares in Sweat Shirts Turn Pupils from Science," Chemical and Engineering News, XXXIV (1956), 236.

[29]"Cool Cats or Squares?" Chemical and Engineering News, XXXIV (1956), 236.

students was conducted by Purdue University. Its main conclusions are interesting. Forty-five per cent of the students questioned believed their school background was too poor to permit them to choose science as a career. Thirty-five per cent believed that it is necessary to be a genius to become a good scientist. Thirty per cent believed that one cannot raise a normal family and be a scientist at the same time. Twenty-eight per cent did not believe that scientists have time to enjoy life. Twenty-seven per cent thought that scientists are willing to sacrifice the welfare of others to further their own interests. Twenty-five per cent thought scientists as a group are more than a little "odd." Fourteen per cent thought there was something "evil" about scientists. Nine per cent believed that you cannot be a scientist and be honest.[30]

The College

Colleges have also been blamed for the scientific manpower shortage. For instance, they have been criticized not only for failing to attract students into chemistry, but also for causing many beginning chemistry majors to change to some other field of specialization. People have said that many college chemistry teachers are not well-trained; that freshman chemistry teachers, especially, have failed to inspire students to select chemistry as a major; that professors of chemistry have not "sold" students on majoring in chemistry; that laboratories have been too crowded and poorly-equipped; that too much time has been required of students for laboratory work; that breakage costs have been excessive; that laboratory work has been hazardous; that many storeroom employees have not

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[30] The Ada Evening News, December 3, 1956, p. 4.

given friendly service; that too many graduate assistants in chemistry could not speak or understand English well; that brilliant students have not been challenged; and that little cooperation has existed between colleges and high schools for producing more scientists.

College Teachers

Some people have claimed teachers of college chemistry are largely responsible for the decrease in percentage of chemistry majors. For example, Joel H. Hildebrand, emeritus professor of chemistry at the University of California and American Chemical Society president in 1955, stated that at the college level tremendous improvement in the quality of science teaching must be made. He said,

"Too often courses in chemistry and physics deteriorate into humdrum presentations of facts to be learned by rote. Missing are the vital elements that stimulate the imagination, encourage students to do original thinking, and arouse curiosity about the whole field of science. . . . <u>The caliber of the teacher is everything</u>. It is better for a student to sit within fifty feet of a great teacher than to sit within five feet of a mediocrity."[31]

Likewise, the president of Bowling Green State University, Ralph W. McDonald, stated,

"Many science courses, especially at the college level, are not designed as learning experience in which young people can gain a comprehension of science in the modern world. Instead, many of these courses are relatively empty and meaningless exercises in the lesser routines of laboratory mechanics from which the professor has frequently squeezed out, as fully as possible, all the elements of individual thinking, stimulation, significance, and meaning. Many poorly-conceived laboratory courses choke, rather than evoke, an interest in science. Worse still, a large proportion of beginning students are given failing grades. In discussions of why so many students fail basic science courses, the explanation most often given is 'lack of preparation'. This is the least valid excuse of all. The job of the teacher is not to teach what another group of students might have learned; it is to teach what the group of students he actually has can learn. The teacher is responsible for designing a

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[31]"Why Race Russia?", <u>Chemical and Engineering News</u>, XXXIV (1956), 2253.

course which his students can learn. If he cannot, he should learn to do so. If he does not want to learn to do so, he may be a scientist, but he is not a teacher. . . . Many potentially great scientists are being literally driven out of the science field as a result of their unrewarding beginning science courses in high school or college. . . . First requisite for a person striving to interest students in a science career is an enthusiasm for science. The best teachers in the department should teach beginning science courses. Sympathetic advisers are another must."[32]

At the spring meeting of the American Chemical Society in 1956, two men stated that it was up to teachers to do a better selling job for chemistry. Carl Marvel of the University of Illinois said,

"More students must be found for chemical training, and ways must be sought to improve the teaching of elementary students in chemistry at the high school and college levels. Teachers must regain the salesmanship quality so as to create interest in chemistry and inspire students to devote the hours needed to master the subject."

Otto M. Smith of Oklahoma State University said that this selling job must be done the freshman year since only about 3% of students who take general chemistry receive a degree in chemistry or chemical engineering. He also felt that the best teachers in the chemistry department should teach the general course. He observed that the better teachers are assigned the general chemistry lectures, but inexperienced graduate students take over the laboratory and quiz section work.[33]

In addition, Samuel Schenberg, supervisor of science in the New York City high schools, has declared,

"Too many capable students are being flunked out of college in their freshman year. The reason for this is that freshmen are puzzled by college teaching methods. Tutoring systems should be established to bridge the gulf between high school and college methodology."[34]

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[32]"Best Teachers for Beginners," Chemical and Engineering News, XXXIII (1955), 1952.

[33]"Urge Schools to 'Sell' Chemistry," Chemical and Engineering News, XXXIV (1956), 1973-1975.

[34]"Tutors for College Freshmen?", Chemical and Engineering News, XXXIV (1956), 1084.

College Program

Some have expressed the opinion that students do not wish to major in chemistry because it interferes with extra-curricular activities. However, since 1952, Chemical and Engineering News has been naming an All-Chemical, All-American football team from among students majoring in chemistry and chemical engineering at universities and colleges with American Chemical Society approved curricula in these fields. This has been done to demonstrate that a career in chemistry or chemical engineering need not mean that demands of the curriculum will prevent all extra-curricular activity.[35]

It has been suggested by Charles Allen Thomas that college curricula be reevaluated to determine whether or not too much stress is being placed on advanced mathematical requirements in preparation for degrees in organic and biochemistry.[36]

Note of Optimism

In October of 1955, a note of optimism appeared in a headline of the Chemical and Engineering News: "Curve Turns Up for Chemistry Graduates." But the opening sentence of the article, "The long-awaited reversal . . . may arrive this year," toned down the headline. The only factors listed to cause the reversal were: efforts made by the American Chemical Society to interest well-qualified young people in the profession of chemistry and the effect of increased birth rate in the late thirties. Toward the latter part of this article the following statement completely

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[35]" C&EN All-Chemical All-American," Chemical and Engineering News, XXXII (1954), 4854.

[36]"Science Suffers from Anemia," Chemical and Engineering News, XXXIII (1955), 3928.

reversed the headline:

Heads of approved departments expect a slight decrease in the number of graduates next year. . . . Possibly the department heads have been overly optimistic in their estimates for the next three years. . . . The greatest increase is expected from the small departments that produce a substantial share of the "reduced majors," graduates who tend not to enter the chemical profession.[37]

Need for the Study

Howard A. Meyerhoff, executive director of the Scientific Manpower Commission, has said, "Bootlegged and unauthentic reports to the contrary, there is a manpower shortage in the fields of science and engineering."[38]

Likewise, M. O. Denekas, chairman of the chemical education division for the Southwest Regional American Chemical Society meeting held in Tulsa, Oklahoma in December, 1957, wrote:

The technical manpower problem was suggested . . . as an area in which papers should be given. . . . Although the shortage of technical manpower is being attacked successfully by people in both industry and education, much more work needs to be done. . . . The following topics suggest areas in which such papers could be given: "More chemists needed. How can we attract them?"[39]

Moreover, concern has been expressed about the trend of Russia's scientific manpower supply compared to America's. Nothing can be done to push the trend downward in Russia. The United States must somehow increase her output of scientists. Herbert Scoville, Jr., assistant director of the U. S. Central Intelligence Agency said, "Competition for (scientific) manpower is not limited to industries within the United

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[37]"Curve Turns Up for Chemistry Graduates," Chemical and Engineering News, XXXIII (1955), 4632-4633.

[38]"No Manpower Shortage?" Chemical and Engineering News, XXXIII (1955), 2519.

[39]Part of a letter to the writer from M. O. Denekas, chairman of chemical education for the 1957 Southwest Regional American Chemical Society Meeting, Tulsa (February 27, 1957).

States but also exists between nations. The nation with the greatest supply will lead the world.[40]

The discussion and citations in this chapter have indicated that there are many opinions of eminent people about when, where, and why students select a major science field such as chemistry and persist in it. But while some persons have stressed one group of factors, others have emphasized different ones. Sometimes exactly opposite viewpoints have been taken.

Occasionally, pertinent questions have been asked and left unanswered, for the answers were not known. For example, Otto M. Smith and Carl E. Marshall made a study of over 1700 colleges and found fewer freshmen taking general chemistry in 1954 than in 1951. These men felt that an investigation of reasons for this decline was needed. They asked the following questions:

> Is (the decline) the result of lack of interest of teachers or the poor teaching of science and mathematics in high school; is it the scarcity of inspiring chemistry teachers in the colleges and universities, or the poor quality of graduate student assistants and laboratory instruction in general; is it the excessive size of the classes of chemistry; is it the poor quality of students, or poorly-prepared students; or is it due to the growing interest in the social sciences? Is the chemistry department too inelastic, relative to other departments, in its requirements for facilities to cope with increasing college population? Are some departments and schools no longer requiring chemistry as a prerequisite, or are they postponing general chemistry to the latter years of college?[41]

The questions were left unanswered.

Furthermore, in another publication the same two men asked, "What are the factors responsible for the drop in bachelor's-degree

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[40]"Russia's Three R's," Chemical and Engineering News, XXXIV (1956), 5722.

[41]Otto M. Smith and Carl E. Marshall, "The 1954 Enrollments in General Chemistry," Journal of Chemical Education, XXXIII (1956), 403-404.

chemistry graduates . . . poor quality or lack of inspirational teaching in general chemistry? Are our professors today selling chemistry as effectively as in the past years? Has the increase in chemistry courses and laboratory sciences in high school reduced the number of college students desiring to major in chemistry?"

These questions were also left unanswered, but the writers effectively stated some needs for the present study. They said,

"In the interest of maintaining a sufficient number of college graduates with majors in chemistry . . . to supply the demand of industry and teaching, our Society of 60,000 members should know more about these freshman students and their interests, their high school preparation, and the influence of the guidance programs in high school and college. We should be aware of the major factors that influence the choices that college students make in selecting their college program. With this information at hand the Society will be in a position to increase interest in science and chemistry and influence the students to study in these fields."[42]

Many Americans have finally concluded that someone or something responsible for the decreasing percentage of chemistry majors needs to be corrected some way and quickly. Just who or what does not seem to be perfectly clear. Neither does the how. Conflicting opinions have been expressed by people equally eminent. Order is needed in place of confusion. Factors <u>actually</u> associated with selection of and persistence in chemistry need to be known, so that more students may be influenced to enter chemistry as a profession.

Oklahoma State University, like institutions of higher learning throughout the country, has experienced a decline in percentage of chemistry majors. Information about factors associated with the selection of and persistence in chemistry as an area of specialization on the part of undergraduate students at Oklahoma State University should be of value as an aid for reversing the trend of decreasing percentage of chemistry majors here as elsewhere.

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[42]Otto M. Smith and Carl E. Marshall, "How Many Students Take General Chemistry," <u>Journal of Chemical Education</u>, XXXI (1954), 658-660.

CHAPTER III

PROCEDURE: GENERAL STRUCTURE AND SELECTION OF POPULATION

The procedure used in the study included the identification of those students, current and past, of Oklahoma State University who had elected to take chemistry sometime in their college experience and either selected or did not select it as an area of specialization. Furthermore, the separation of the selectors into two groups, those who persisted and those who did not persist in chemistry as a major, was involved.

The procedure also required the development and use of a rating scale and the involvement of faculty members of land grant colleges of the United States.

Selection of Student Populations

If a student had completed his college work with a bachelor of arts or a bachelor of science degree in chemistry, he was regarded as persisting in chemistry. If he was currently enrolled and still majoring in chemistry, he was also regarded as persisting in chemistry. If he had selected chemistry as a major and then completed his undergraduate work with a degree in some other field, he was classified as non-persistent. Also, if he was currently enrolled and majoring in something other than chemistry, after having once declared chemistry as his major, he was considered non-persistent. If a student had elected to take one or more courses in chemistry before declaring in writing what his major was and then selected some other field as an area of specialization, he was regarded as a non-selector of chemistry. Hence, three different groups of students were included in the study: selectors and persistors, selectors and non-persistors, and non-selectors.

Two student populations were included in the study: students who were interviewed and students who were asked to respond to an inquiry form. Those who were interviewed were among students currently enrolled at Oklahoma State University during the second semester of the school year 1955-56. Those who were asked to respond to an inquiry form were among students who graduated from Oklahoma State University during the period 1953 to the first semester of 1956. A description of the process of identifying the selectors and persistors, the selectors and non-persistors, and the non-selectors in the two populations follows.

Examination of Directories of Advisees

The first source of information for identifying currently-enrolled students and graduates was directories of advisees on file in offices of the Dean of the College of Arts and Sciences. It was necessary to examine records as far back as 1948-49 in order to identify students who might have been freshmen that year and who became non-persistors or non-selectors of chemistry. The directories were checked for names of chemistry majors and for names of students who were undecided about a major. In the directories, under the heading of major, the word "general" was used for those students who had not selected an area of specialization. One 3 x 5 inch card was made for each student. The exact terms when he listed chemistry as a major or wrote "general," if undecided about a major, were recorded on the card. Also, the student's classification for each term was written on the card. Other pertinent information, such as A.C.E. score, note of transfer to a different college on the campus, honorable or dishonorable discharge from Oklahoma State University, transfer from some other college on the campus to the College of Arts and Sciences was recorded.

Examination of Records in Registrar's Office

After the writer obtained the names of all undergraduates at Oklahoma State University during the years 1948-49 to 1955-56, inclusive, who had declared in writing at least once their intention of majoring in chemistry or who had given general for their major, the next step in the procedure was to check transcripts of these students in the registrar's office. The purpose of this step was to determine whether the student received a degree with a major in chemistry or some other field, whether he was a drop-out, whether he was currently enrolled, and if so, what his major was. At the same time, other information on the transcripts useful in solving the problem was recorded. This information included parents' address, when and where the student was born, what high school he graduated from and when, what high school courses he had taken, what grades he had made in college chemistry courses, when he entered Oklahoma State University for the first time, and whether he had his chemistry at Oklahoma State University or somewhere else.

In the beginning, obtaining the transcripts for use involved looking up the student's transcript file number in an alphabetical card file of all current and former Oklahoma State University students. This number, along with the student's name, was written on a 4 x 12 inch card. Several of these cards were then given to a young man employed in the registrar's office. He pulled the transcripts, left the 4 x 12 inch cards in their places, and brought the transcripts to a desk assigned the writer. After the writer had all the information needed from the transcripts, he would place them in a box marked "transcripts to be filed."

Later the registrar permitted the writer to pull the transcripts and re-file them. This courtesy made it possible for the writer to examine more transcripts in a day than when he had to depend upon a part-time student helper to pull enough transcripts to supply the needs of the writer.

Transcripts for currently-enrolled students were in a separate file and were harder to obtain because office helpers were constantly working on some of them. Eventually, however, approximately 2000 transcripts needed for the study were examined.

Student Identification Summary

Information from the directories and transcripts showed that 165 students included in the study were enrolled during the second semester of 1955-56 and were to be interviewed. Sixty-seven of these were persistors, twenty-four were non-persistors, and seventy-four were non-selectors of chemistry. The records also showed that eighty-six students, who had received degrees from Oklahoma State University during the years 1953 to 1956, were not enrolled the second semester of 1955-56, and would be sent inquiry forms. Twenty-eight of these were persistors, twenty-six were non-persistors, and thirty-two were non-selectors of chemistry. Included in both populations were ninety-five persistors, fifty non-persistors, and 106 non-selectors, a total of 251 students. Table I shows the number of students in the various groups of the two populations.

TABLE I

STUDENT POPULATIONS BY GROUPS

Student Groups	Students Interviewed	Students Sent an Inquiry Form	Totals
Persistors	67	28	95
Non-persistors	24	26	50
Non-selectors	74	32	106
Totals	165	86	251

It was assumed that these 251 students who decided whether or not they would select chemistry and persist in it could provide information from which factors which occasioned their decisions could be identified. An editorial by Walter J. Murphy in Chemical and Engineering News stressed the importance of student opinions. He wrote:

> Literally millions of words have been spoken and written on the subject of manpower shortages in most of the professions. Yet, as far as we are aware, little or no effort has been made to ask . . . students why so many of them decline to seek careers in the professions. We have heard a great deal from educators, employers, high school teachers, professional employees, and, yes, even from editors, but little or nothing from the youngsters, who, in the final analysis, are the ones to make the fateful decision.[1]

Likewise, Albert E. Lawrence of Cornell University stated,

> Although considerable space has been devoted to what the college faculty want, little has been mentioned as to what the students think is necessary for success in first-year college chemistry.[2]

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[1]Walter J. Murphy, ed., Chemical and Engineering News (Washington, D. C., 1955), p. 4631.

[2]Albert E. Lawrence, "Articulation of High School and College Chemistry Instruction," Journal of Chemical Education, XXXII (1955), 25-28.

CHAPTER IV

PROCEDURE: RATING SCALES AND INTERVIEW

Information that revealed factors associated with selection of and persistence in chemistry on the part of the two student populations was obtained by interviewing the students currently enrolled, and by sending an inquiry to the graduates; to interview the latter was impractical. Opinions generally held about what the factors are, were gleaned from the literature on education in chemistry and from informal conversation with students and faculty members at Oklahoma State University. Then these opinions were used to develop a rating scale of 127 items which was sent to properly qualified people in land grant colleges who passed judgment upon the items. The assistance of these qualified people was obtained with the help of the presidents of the land grant institutions.

In the light of the collective judgment of land grant college experts, the original list of 127 items was revised. The revised list was used for two purposes: (1) to develop a guide for interviewing students currently enrolled, and (2) to develop a rating scale to be mailed to graduates of Oklahoma State University.

Designing the Original Rating Scale

To develop this scale a number of items which appeared promising were gathered and organized so that qualified persons could pass judgment upon them. To organize the rating scale, the items were divided into two main categories: (1) factors which favor the selection of chemistry as an area of specialization by college undergraduates, and (2) factors which favor persistence in chemistry as an area of specialization by college undergraduates.

Items in the two main categories were subdivided into what seemed to be natural groupings. The first of these two categories was divided into factors connected with experiences of students in the elementary school, secondary school, college, home, and with the public and government. Certain personal factors were also included. The factors of the second category were subdivided into those connected with the college student's experiences in the classroom and laboratory. Certain personal factors, along with a few which had no common basis for classification (called miscellaneous factors), were also included. The classification used seemed to satisfy the requirements of satisfactory categorization.[1]

The scale for rating each factor took the form of always-usually-occasionally-seldom-never and no opinion, with regard to the frequency with which the respondent believed the factor favored selection of or persistence in chemistry as an area of specialization. No attempt was made to force an opinion about each factor. If the person checking the list had no opinion about a certain factor he would check the "no opinion" blank. Also, space was made available for including additional factors which the land grant college educator believed were pertinent to selection of and persistence in chemistry. An example drawn from the first page of the scale follows:

FACTORS WHICH FAVOR THE <u>SELECTION</u> OF CHEMISTRY AS AN AREA OF SPECIALIZATION BY COLLEGE UNDERGRADUATES

To the right of each of the factors listed are six blanks. By means

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[1]Carter V. Good and Douglas E. Scates, <u>Methods of Research</u> (New York, 1954), p. 682.

of a check mark (✓) please indicate the frequency with which you think the factor always, usually, occasionally, seldom, or never favors the SELECTION of chemistry as an area of specialization by college undergraduates. There may be factors about which you have no opinion. If so, place a check mark in the sixth blank.

	Always	Usually	Occasionally	Seldom	Never	No opinion
I. Factors Connected with the Elementary School Experiences of Students	____	____	____	____	____	____
(1) Adequacy of mathematics taught in the elementary grades	____	____	____	____	____	____
(2) Adequacy of science taught in the elementary grades	____	____	____	____	____	____

A copy of the complete rating scale may be found in Appendix E.

Efforts were made to construct the rating scale so that it would not weary or antagonize the person checking it. Duplicating items were not used except when absolutely necessary; however, in some instances it was felt that repetition of items was necessary. For example: "Abilities of chemistry laboratory instructors to speak and understand English well" was repeated in the two general categories in the belief that it could influence a student not only to select chemistry as a major but to persist in it. Items representing similar factors were grouped and were stated clearly and briefly. Loaded expressions were avoided. Positive rather than negative statements were striven for.

How Qualified Persons from Land Grant Colleges Were Selected

The original rating scale included what was hoped to be a comprehensive listing of factors believed to be associated with the selection of and persistence in chemistry as the major area of specialization on the part of undergraduate students in general. Since the problem of the study was limited to students of Oklahoma State University, a land grant institution, the assumption was made that factors associated with selection of and persistence in chemistry in such institutions might differ somewhat from those of the entire country. F. D. Farrell wrote:

From the beginning the land grant colleges have been peculiarly American. They are open to all qualified comers, they are democratic, and they are actively concerned with the well-being of the millions of citizens who work for a livelihood. Their success has been so marked and their acceptance by the public so widespread that numerous other countries on all the continents have invited them to send delegations to explain the land grant college idea and how it operates. . . . The major change in these institutions during the past fifty-five years is the transformation of these colleges from small, weak, struggling, widely unpopular institutions to large, influential state and national scientific and educational agencies enjoying widespread public acceptance. . . Another major development since 1900 is a marked increase of specialization not only in agriculture, engineering, and home economics, but in such basic subjects as chemistry, botany, and zoology.[2]

A list of land grant colleges in the United States was obtained from an Office of Education bulletin.[3] Then current catalogs for the land grant colleges, on file in the education section of the library of Oklahoma State University, were used to obtain the names and addresses of the college presidents. A complete mailing list of presidents is shown in Appendix A.

A letter including a brief description of the study and a request to designate a person at his institution best qualified to pass upon the

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[2]F. D. Farrell, "The Land Grant Colleges Since 1900," College and University, XXXI (1956), 302-308.

[3]Arthur J. Klein, Survey of Land Grant Colleges and Universities, U.S. Department of Interior's Office of Education Bulletin No. 9 (Washington, 1930), p. 16.

relative importance of the various factors included in the rating scale was sent to the president of each land grant college. The letters were written on letterheads of the Department of Chemistry, Oklahoma State University, and signed by the head of the department, whose professional and personal interest in the study was expressed. A copy appears in Appendix B.

Forty-five of the forty-seven land grant colleges contacted through their presidents' offices replied. Only the University of New Hampshire and South Dakota State College failed to reply. Table II shows the number and per cent of presidents of land grant colleges responding.

TABLE II

TABULAR SUMMARY OF THE NUMBER OF REPLIES FROM LAND GRANT COLLEGE PRESIDENTS

Number of Presidents to Whom Letters Were Sent	Number of Replies from Presidents	Per Cent of Presidents Responding
47	45	96%

All forty-five presidents cooperated by giving the name and address of a college staff-member at their institution, who was well-qualified to judge the relative importance of various factors in the selection of and the persistence in chemistry by undergraduates. The names of the staff-members, their titles, and the institutions they represent are shown in Appendix C.

In general, the presidents recognized a need for this study. They expressed cooperation and extended good wishes, as evidenced by one comment: "I was very interested in the study mentioned in your letter . . . . Best wishes to you for the successful conclusion of your study."

Letter of Transmittal to Educators
in Land Grant Colleges Who Were
Selected by Their Presidents

A letter of transmittal was sent with a copy of the 127-item rating scale to each person selected by presidents of land grant colleges. Again, the letter was written on letterheads of the Department of Chemistry, Oklahoma State University, and signed by the head of the department.

The opening paragraph of the letter stated,

This department is studying the factors positively associated with selection of and persistence in chemistry as an area of specialization by college undergraduates. You have been designated by your college president as the staff member at your institution who is well-qualified to estimate the relative importance of such factors.

Then the terms: factor, positively associated, and persistence were defined so that everyone checking the rating scale would be applying the same meaning to the expressions.

Next, the division of the 127 factors into categories and subdivisions was explained.

Finally, the person who was selected to do the checking was told exactly what he was to do, so there would be no misinterpretation of the request.

A copy of this letter of transmittal is in Appendix D.

Revising the Rating Scale

Persons intimately associated with education in chemistry in land grant colleges passed judgment upon the various factors included in the rating scale. On basis of the agreement of these judgments, the rating scale was revised. The steps taken in the process follow.

Results From the Inquiry to
Educators in Land Grant Colleges

In all, thirty-seven faculty respondents of land grant colleges filled in the rating scales and returned them. In Table III the number and per cent of educators returning the rating scales are shown. The procedure used in summarizing their ratings follows.

TABLE III

TABULAR SUMMARY OF THE NUMBER OF REPLIES FROM EDUCATORS DESIGNATED IN LAND GRANT COLLEGES

Number of Educators to Whom Rating Scales Were Sent	Number of Replies from Educators	Per Cent of Educators Responding	Per Cent of All Forty-seven Land Grant Colleges Fully Cooperating
45	37	82%	79%

A frequency count was made to see how many times "always," "usually," "occasionally," "seldom," "never," and "no opinion" were checked for each of the 127 items. The numbers +2, +1, 0, -1, -2 were assigned to "always," "usually," "occasionally," "seldom," and "never," respectively. Then the number of times an item had been checked always was multiplied by +2, the number of times an item had been checked usually by +1, and so on for the five intervals. Then the sum of the products, the weighted score, was calculated. The greater the positive weighted score the more frequently that factor was adjudged to favor selection of or persistence in chemistry. The lower the value of a weighted score the less frequently that factor was adjudged to favor selection of or persistence in chemistry.

In Table IV, item (4), under factors connected with the college experiences of students, is used to illustrate how the weighted scores of the 127 items were calculated.

TABLE IV

CALCULATION OF THE WEIGHTED SCORE, ITEM (4) "EMPHASIS BY FRESHMAN CHEMISTRY TEACHERS ON THE NATIONAL IMPORTANCE OF MAJORING IN CHEMISTRY"

N = 37

Rating	Frequency	Weight	Weighted Rating
always	2	+2	+4
usually	15	+1	+15
occasionally	14	0	0
seldom	5	-1	-5
never	1	-2	-2
		Weighted score	+12

The items were then arranged in order of algebraic decrease of values of weighted scores and a rank given to each. Some items had the same score and, therefore, the same rank. For example, under factors favoring selection of chemistry, an item having a weighted score of (+35) was given a rank of 13. The next two items had the same weighted score of (+32). They were ranked 14.5 and 14.5. Then the next item, which had a score of (+31), was ranked 16.[4]

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[4]Cf. A. S. Barr, R. A. Davis, and P. O. Johnson, Educational Research and Appraisal (Chicago, 1953), pp. 74-81: "Rating is a term applied to expression of opinion or judgment regarding some situation, object, or character. . . . Opinions are usually expressed on a scale of values. Rating techniques are devices by which such judgments may be quantified.

The weighted scores and rank order for the seventy-nine items listed under selection and the forty-eight under persistence were calculated. See Appendix F. The maximum score possible for any item, had all thirty-seven respondents checked "always" would have been (+74). The minimum score would have been (-74). Had all thirty-seven checked "usually" a score of (+37) would have been realized, and if they had all checked "seldom," a score of (-37). If they had all checked "occasionally," the score would have been zero. The theoretical scores, then, if all thirty-seven had checked the same space, are: (+74), (+37), (0), (-37), (-74). This would be a discrete scale. Actually a continuous series is involved. (0) really represents an interval (-18 to + 18). Therefore, from the highest to the lowest scores the terms "always," "usually," "occasionally," "seldom," "never" would be represented by the following intervals, respectively: (+92 to +56), (+55 to +19), (+18 to -18), (-19 to -55), and (-56 to -92). These intervals and others with different

4 (cont'd) . . . _Quantification is effected by transmuting letter designations or verbal characterizations into numbers, and by computing a total score._ The total score is a number representing an empirical index of value interpretable in terms of the rating device used. . . . A five-space scale may bear for each interval numerical designation (1, 2, 3, 4, 5), verbal designations ("never" to "always"), or both numerical and verbal designations. If the intervals are not designated by number, _the investigator transmutes the letters or verbal terms into numbers when scoring._ Odd numbers or intervals are most commonly used, since such a plan permits making a mid-point as neutral or average rating. . . . _Rating scales are frequently used_ . . . _in situations in which canvassing opinion is the only source of dependable information. The method of quantification used in a rating device is essentially that of rank order._

Cf. Allen Edwards, _Experimental Design in Psychological Research_ (New York, 1950), p. 6: Responses . . . may be in terms of whether the subject strongly agrees, agrees, is undecided, disagrees, or strongly disagrees with the item. How do we quantify such responses? . . . It is an arbitrary matter, but for convenience we often assign weights involving the successive integers zero to four to such item responses. Although these responses constitute a qualitative series, we arbitrarily quantify them by assigning some such weights.

values were used, so that the writer would have a common basis for comparing ratings of factors, "always" to "never," by different-sized groups.

Only the item with rank order number one in the original rating scale was considered by land grant college educators as always favoring the selection of chemistry. Items with rank order numbers two to thirty-seven, inclusive, usually favor selection. Those with numbers thirty-eight and one-half to seventy-seven and one-half, inclusive, occasionally favor selection. Only the item with rank order number seventy-nine seldom favors selection of chemistry. No item in the list never favors selection, according to land grant college educators.

Only two items, rank order numbers one and two, were considered as always favoring persistence in chemistry. Items three to eighteen and one-half, inclusive, usually favor persistence. Items twenty and one-half to forty-five occasionally favor persistence in chemistry. Three items, numbers forty-six to forty-eight, seldom favor persistence. No item in the list never favors persistence, according to land grant college educators.

A tabular summary of the rating frequency, weighted score, and rank of each item in the original rating scale of 127 items is shown in Appendix F.

Additional Factors Listed and Rated by Land Grant College Educators Which They Thought Were Pertinent to Selection of Chemistry

Twenty-one of the thirty-seven rating scales returned did not have any additional factors listed for either selection or persistence in chemistry. Of the sixteen which did have other factors, there were thirteen suggesting one or more factors associated with selection and eleven listing one or more factors associated with persistence. Some gave additional factors for selection only, some suggested factors for persistence only, and others listed factors for both selection and persistence.

Twenty-eight additional factors which land grant college educators thought were associated with selection of chemistry as a major were listed. These factors and the ratings given them are shown in Table V.

The first twenty-three of the twenty-eight additional items listed in Table V were included actually or by implication in the 127-item rating scale. The last five items were not. The responses in this category were very wide and varied. An isolated example of this wide variation is number twenty-eight in Table V, "Religious or social motivation as a result of religious philosophy." The respondent gave the following additional explanation in a letter accompanying the checked rating scale:

Out here in the west we have a high concentration of young men and women from the Church of Jesus Christ of Latter Day Saints. We find that many are motivated by their religious philosophy which can be stated in a couple of their sayings: "The glory of God is intelligence" and "Man is saved no faster than he gains knowledge." Accordingly, many of this faith choose science as a career, particularly chemistry and physics, because of the challenge it affords.

One of the persons checking the 127-item rating scale sent a two-page letter (typewritten single-spaced) along with the rating scale. Some of his comments are interesting. He wrote:

I have been interviewing students for over twenty years and I think I have come to some reasonably reliable conclusions. A high school chemistry course taught by a good teacher in a well-equipped laboratory is the greatest single factor in getting students to take chemistry in college. A poor course, taught by a poor teacher and often using demonstrations only, with no individual laboratory work for the student, has been a potent factor in turning students away from chemistry. Students generally agree that general science is poorly taught in high schools and is seldom a factor in interesting them in chemistry or physics although many have been interested in biology as a result of general science. This is due to the fact that most teachers of general

TABLE V

ADDITIONAL FACTORS ABOUT SELECTION OF CHEMISTRY LISTED BY LAND GRANT COLLEGE EDUCATORS AND THE ACCOMPANYING RATINGS

	Factor	Rating
1.	Remuneration in other fields requiring less effort in college	Usually
2.	Finances	Occasionally
3.	Financial rewards resulting from completing professional training as chemists	Occasionally
4.	General public concept of chemists being non-social introverts	Usually
5.	General intelligence of teacher	Usually
6.	Enthusiasm of high school teacher	Always
7.	Ability of high school teacher to teach	Always
8.	Unusually inspiring high school teacher	Usually
9.	Inspiring high school teacher about the junior or senior year in high school	Usually
10.	Older students majoring in chemistry	Occasionally
11.	Relative who is a chemist	Occasionally
12.	Acquaintances working as chemists	Usually
13.	Friends majoring in chemistry	Usually
14.	Occupation of parents	Occasionally
15.	Father or mother a chemistry major when in college	Occasionally
16.	Older brother a chemistry major	Occasionally
17.	Availability of professional chemists in a student's hometown and at chemical industrial establishments	Occasionally
18.	Knowledge of the results of research policies of chemical companies	Usually

Table V (continued)

	Factor	Rating
19.	Indifferences of the American Chemical Society toward the professional status of the chemist	Occasionally
20.	General attitude of the public that chemistry is a difficult subject requiring the talents of a genius or near-genius	Occasionally
21.	Attitude that professional chemistry curriculum is leading to Ph. D. and an eight-year degree and essential for career in chemistry	Occasionally
22.	Students with an aptitude in mathematics, physics, etc. tend to like chemistry	Usually
23.	Length of time needed to complete professional training (need for graduate study)	Usually
24.	Creating an awareness on the part science plays in creating and developing the needs of present and future civilizations at the elementary level and continued through the secondary school level	Always
25.	Disappointment with laboratory experiments which do not work well	Occasionally
26.	Ratio of M. D.'s and dentists to chemists in student's hometown	Usually
27.	Imagination and originality	Always
28.	Religious or social motivation as a result of religious philosophy	Usually

science have had some biology and the student can collect leaves, flowers, insects, birds, etc. While poor preparation in mathematics is seldom realized by students entering college, it is a major factor in causing students to drop out of chemistry at the end of the Freshman year. Inability to read well and understand what is read is a major factor in all courses - certainly not peculiar to chemistry. A large percentage of students today are lazy and avoid all science and mathematics if possible. Business administration, journalism, fine arts have grown greatly because they have the reputation of being easy - and our records show that they are. Failures are few and students with low IQ ratings do quite well in these fields as a rule. Financial reward seems to be a minor factor. Never have such salaries been offered to chemistry graduates as those of today, yet fewer are choosing sciences. Respect for the professions has declined greatly because minimum wage laws make it possible for anyone who can read, breathe, and move to make a good wage. Students know this. They see carpenters, brick layers, mechanics, etc. making more money than most professional people. They have never known an economic depression and many of their parents have forgotten about it. Their parents, in general, distrust intellectual activity because it has been linked too much to communism. In short, our government in too many cases has made lazy, indifferent people content with high wages, social security, and a new automobile. It has made them afraid to think and express themselves. Poor salaries drove the better teachers out of high school and elementary schools. Teachers colleges turned out a generation of socially-conscious people with certificates to teach "children" - no academic discipline, no stimulation of imagination, no encouragement of experimentation, - just this futile attempt to "adjust each future citizen to the total environment of his community at all levels of the total curriculum." Hog wash! No wonder the average citizen confuses teachers with educated persons. Some how we must require that teachers are educated persons rather than holders of certificates to teach children. . . . In my opinion we need different requirements for high school teachers and return to algebra and geometry even if folk dancing and civics have to be eliminated. No one has claimed that chemistry is good training for a football coach so why is football any training for teaching chemistry? I know several schools in which the coaches are assigned classes in mathematics, chemistry, and general science because they are good at making boys behave! We are not blameless in colleges and universities. We must recognize good teachers and good teaching and see that freshmen are taught well and inspired, without discouraging research by the faculty. I think the best men in a department should teach freshmen - not graduate students and fresh Ph. D.'s! . . . . We have had considerable success in having men from public relations departments of industries come to our campus and tell the young people about careers through chemistry in their companies.

Additional Factors Listed and Rated
by Land Grant College Educators
Which They Thought Were Pertinent
to Persistence in Chemistry

Twenty additional factors which land grant college educators thought were associated with persistence in chemistry were listed. These factors with the accompanying ratings are shown in Table VI.

TABLE VI

ADDITIONAL FACTORS ABOUT PERSISTENCE IN CHEMISTRY LISTED BY LAND GRANT COLLEGE EDUCATORS AND THE ACCOMPANYING RATINGS

	Factor	Rating
1.	Remuneration in other fields requiring less effort in college	Usually
2.	General public concept of chemists being non-social introverts	Usually
3.	Remuneration balanced against effort required to achieve excellence	Always ($)
4.	Effort required	Usually
5.	Close general contact with chemistry staff members by student	Always
6.	High school preparation	Always
7.	Easier curriculum than chemistry	Usually
8.	Determination - stubborness, if you will	Always
9.	Effort to acquaint students with the possibility of carrying on minor research programs on the undergraduate level	Always
10.	Possibilities for undergraduate research in senior year	Always
11.	Acquaintances working as chemists	Usually
12.	An up-to-date chemical plant in or near their home	Usually
13.	Past records of graduates in the department	Occasionally
14	Effort made to encourage attendance at American Chemical Society sectional meetings	Usually
15.	Summer employment in industrial laboratories	Usually

Table VI (continued)

Factor	Rating
16. Department "esprit de corps" and total attitude toward chemistry as a profession is very important. A student likes to feel that his teachers are proud of their profession	Usually
17. The more personalized a staff can make the student's experience in chemistry the better. Chemistry clubs, seminars, work for the department, etc., all help	Always
18. Belief that chemistry will be of value in the study of medicine, dentistry, or nursing - many of our majors go into these fields later	Usually
19. Availability of lecturer for informal discussions	Usually
20. Personal and first hand knowledge of lecturer on specific subjects, e.g. industrial processes, uses and applications of products - experience of lecturer	Usually

The first five of the twenty additional factors listed in Table VI were included actually or by implication in the 127-item rating scale. The last fifteen items were not.

In some instances, the additional factors given by land grant college professors about selection and persistence in chemistry reinforced the 127-item rating scale. For example, the additional factor "general attitude of the public that chemistry is a difficult subject requiring the talents of a genius or near-genius" was rated as only occasionally favoring selection of chemistry as an area of specialization. Included in the rating scale was the factor "scuttlebutt from other college students concerning the degree of difficulty of chemistry courses." It was the consensus of thirty-seven respondents that this factor also only occasionally favored selection of chemistry as a major. In other cases, the additional factors were somewhat different. For example, the factor "religious or social motivation as a result of religious philosophy" was listed by one respondent as usually favoring selection of chemistry as a major. There was no factor in the 127-item rating scale even remotely resembling it, and no other respondent listed it as an additional factor. Alike or different, however, the whole tenor of additional remarks was illustrative of the general concern that chemistry professors feel about the problem of attracting and holding students in chemistry.

Identification of Items Included
in the 45-Item Rating Scale

This step in the revision of the original rating scale was concerned with the identification of those items in the 127-item scale that should be included in the 45-item rating scale sent to graduates of Oklahoma State University.

The selection of forty-five for the number of items to be sent to graduates was done with arbitrariness. It was believed that there would be very few returns if the entire 127-item rating scale were sent graduates. It was thought that forty-five items would be about the maximum number this group of graduates would check and return.

Twenty-eight of the forty-five items were chosen from factors dealing with selection, and seventeen were chosen from those having to do with persistence. These particular numbers were selected because in the 127-item rating scale, sixty-two per cent of the factors listed were about selection, and thirty-eight per cent were about persistence. Sixty-two per cent of forty-five is twenty-eight, and thirty-eight per cent of forty-five is seventeen.

Furthermore, of the twenty-eight items dealing with selection, sixteen were taken from the top and twelve from the bottom. These particular numbers were selected because in the forty-five items, fifty-six per cent of the factors were from the top and forty-four per cent from the bottom. Fifty-six per cent of twenty-eight is sixteen, and forty-four per cent of twenty-eight is twelve.

In addition, of the seventeen items dealing with persistence, nine were taken from the top and eight from the bottom. Fifty-six per cent of seventeen is 9.52% and forty-four per cent of seventeen is 7.48%. In counting down from the top, the tenth item was a choice between three items with the same rank, whereas counting up from the bottom, the eighth item was a choice between two items with the same rank. Since the fractions of per cent were both close to 0.5%, the extra item was selected from the bottom because there was one less item having the same rank.

Accordingly, there were four groups of items included in the forty-five item rating scale: sixteen items from the top dealing with selection, twelve from the bottom about selection, nine from the top dealing with persistence, and eight from the bottom about persistence. Tables VII, VIII, IX, and X show the items included in the four groups and the rank of each item.

Finally, all forty-five items given in Tables VII to X, inclusive, were organized into a rating scale, a copy of which is in Appendix H.

The form of the forty-five-item rating scale was similar to the one containing 127 items. However, the subdivision of the two main categories, selection and persistence, was not believed necessary since this rating scale had fewer items. The twenty-eight items about selection

TABLE VII

SIXTEEN ITEMS MOST FREQUENTLY DESIGNATED BY LAND GRANT COLLEGE EDUCATORS AS ASSOCIATED WITH SELECTION OF CHEMISTRY AS A MAJOR AND LISTED IN RANK ORDER

Item Number	Item	Rank
VI_1	Scientific interests of students	1
III_2	Abilities of freshman chemistry teachers to inspire students	2
VI_2	Scientific aptitudes of students	3
III_8	Abilities of professors to gear instruction in the theory of general chemistry to the level of beginning students	4
III_6	Friendly and helpful attitudes on the part of college chemistry teachers toward their freshman students	5
II_2	Adequacy of science taught in the secondary schools	6
III_1	Training of college chemistry teachers	7
VI_5	General intelligence of students	8
II_{16}	Attitudes of high school counselors toward the pursuit of chemistry	9
II_{17}	Efforts made to detect and encourage college-bound students with science talent to select chemistry in college	10½
II_{21}	Students having had chemistry in high school	10½
II_3	Quality of the background in chemistry obtained by high school students	12
II_1	Adequacy of mathematics taught in the secondary schools	13
I_7	Efforts made from the fifth through the eighth grade to detect and encourage students with science talent to select science and mathematics courses in high school	14½
II_8	Academic qualifications of high school chemistry teachers	14½
II_7	Training of physics, biology, and general science teachers in the secondary schools	16

TABLE VIII

TWELVE ITEMS LEAST FREQUENTLY DESIGNATED BY LAND GRANT COLLEGE EDUCATORS AS ASSOCIATED WITH SELECTION OF CHEMISTRY AS A MAJOR AND LISTED IN RANK ORDER

Item Number	Item	Rank
I_5	Moderate size of classes in elementary schools	67½
VI_7	Extent to which students participate in extra-curricular activities	69
III_3	Attitudes of chemistry storeroom employees toward students	70
II_{19}	Students' having had biology in high school	71½
III_{24}	Amount of emphasis in general chemistry on the cultural aspects of chemistry	71½
II_5	Adequacy of English courses taught in high school	73½
VI_8	Extent of participation in social activities by students while attending college	73½
III_9	Conflict between chemistry course schedules and jobs essential to students' staying in college	75
II_{13}	Extension of the high school academic year to ten or eleven months	76
III_{14}	Safety records in college chemistry laboratories	77½
VI_4	Age of students	77½
III_{15}	Low departmental standards for majoring in chemistry	79

TABLE IX

NINE ITEMS MOST FREQUENTLY DESIGNATED BY LAND GRANT COLLEGE EDUCATORS AS ASSOCIATED WITH PERSISTENCE IN CHEMISTRY AS A MAJOR AND LISTED IN RANK ORDER

Item Number	Item	Rank
I_3	Abilities of chemistry professors to inspire students	1
II_{10}	Scientific aptitudes of students	2
I_6	Friendly and helpful attitudes on the part of chemistry professors toward their students	3
II_1	General intelligence of students	4
I_{14}	Abilities of professors to gear instruction in the theory of general chemistry to the level of the beginning student	5½
I_1	Training of chemistry professors in chemistry	5½
I_{15}	The degree to which brilliant chemistry students are challenged to do the best of which they are capable	7
III_{10}	Adequacy of advisement for chemistry students after selection of chemistry as their major	8
I_4	Adequacy of equipment in college chemistry laboratories	9

TABLE X

EIGHT ITEMS LEAST FREQUENTLY DESIGNATED BY LAND GRANT COLLEGE EDUCATORS AS ASSOCIATED WITH PERSISTENCE IN CHEMISTRY AS A MAJOR AND LISTED IN RANK ORDER

Item Number	Item	Rank
II_{13}	Degree of students' physical handicaps	40½
I_{18}	Emphasis on the disciplinary aspects in courses in general chemistry	42
I_{8}	Necessity of spending three hours in chemistry laboratory work per week for one semester-hour credit	43½
II_{16}	Conflict between chemistry course schedules and jobs essential to students' staying in college	43½
I_{11}	Attitudes of chemistry storeroom employees toward students	45
I_{19}	Emphasis on the cultural aspects in courses in general chemistry	46
I_{7}	Safety records in college chemistry laboratories	47
I_{9}	Policies about breakage costs in chemistry laboratory work	48

and the seventeen about persistence were placed in their respective categories at random. Instead of being provided with two pages to list and rate other factors which he thought were pertinent to the study, the graduate was asked to do the following: "Please use the backs of pages 1, 2, and 3 for brief statements about why you did or did not select chemistry as a major, why you did or did not persist with chemistry if you selected it as a major, and suggestions for improvement of the chemistry department at Oklahoma State University so that it may attract and hold more chemistry majors."

A letter of transmittal accompanied the 45-item rating scale. The letter was written on paper provided by the writer and signed by him since it was believed that graduates would be more inclined to reply to a student than to a department head. Especially would this be true for students who had not persisted with chemistry and those who had not selected it as a major. The graduate was assured that his name would not be used in any report. Directions for checking the rating scale and for answering questions about his experiences with chemistry at Oklahoma State University were given. A copy of this letter of transmittal is in Appendix G.

The total of eighty-six graduates who were sent the 45-item rating scale made up the entire population included in this part of the study. A few replies from this group came from Korea and Germany where the former students were stationed. The data for all replies to the 45-item rating scale were quantified and organized in the same manner as for the 127-item scale.

The Interview

For this study the interview was considered to be an individual, face-to-face conversation for the purpose of gaining information from the person interviewed. "Certain types of information can be secured only by direct contacts with people."[5] The knowledge desired included reasons why students did or did not select chemistry as a major; and if they did select it, why they did or did not persist. Three different groups of students were interviewed:

(1) Those who had selected chemistry as a major and persisted.

(2) Those who selected chemistry as a major but did not persist.

(3) Those who elected to take one or more courses in chemistry but did not select it as a major.

Information obtained from the current enrollment cards in the registrar's office was used to locate the students. Their college addresses were used first. If the student could not be found at home, he was contacted before or after his scheduled class or laboratory, and arrangements were made for the interview at a time and place convenient for the student. Almost all of the students were interviewed at their place of residence. Fifty-five per cent were interviewed at an off-campus residence where the student lived in a room, apartment, or entire house. Twenty-seven per cent were interviewed in dormitory rooms or parlors. Ten per cent were interviewed in fraternity or sorority houses. Four per cent were interviewed where they were working part-time. Four per cent, which included the commuters, were interviewed in campus classrooms, laboratories, or library. About half the interviews were conducted dur- the day and about half from six-thirty to ten at night. Most of the interviews were conducted during the school week. Students were difficult

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[5]Carter V. Good and Douglas E. Scates, Methods of Research (New York, 1954), p. 637.

to find during week-ends. In several cases many trips had to be made to a student's residence before he was found. Some required as many as ten trips. One evening, from 6:30 to 9:30 p.m., the writer knocked on ten doors at about one-hour intervals and found only one person home. But finally the interviewer had the satisfaction of knowing all had been interviewed.

The interviewing process used for this study allowed the interviewer to use the experience acquired in seventeen years of teaching. Fourteen of those years were at the college level as head of chemistry departments where a great deal of personal counseling had been given students. Another factor which supported the interviewer in establishing rapport with the interviewees was the fact that he was personally acquainted with several of them. Some were classmates of his son who was majoring in chemistry. In fact, his own son was one of those interviewed. Others had been the interviewer's students at other schools and at Oklahoma State University. A few were from his home town and knew his relatives and friends. Several were from towns in which the writer had formerly lived and worked. Some were children of the interviewer's former undergraduate classmates and campus friends. One had an aunt who was also the writer's aunt by marriage. So the interviewer did not feel that he was interviewing complete strangers. There was usually some approach to an interviewee which would cause the student and interviewer to feel that they had been friends a long time. Interviewees cooperated by talking freely. They seemed eager to contribute to the solution of the problem.

The Interview Proper

In a general sense each interview was conducted in much the same manner as another. However, in detail the interview was an individual matter. Free response technique was employed, so that the interviewer would not influence the interviewee to give just certain bits of information. The interviewee was allowed freedom to recall what he believed influenced his choice to select or reject chemistry as a major and to persist or not persist in it. When conversation tended to lag, the interviewer would ask a question which would stimulate recall of events during a particular time in the interviewee's experience; however, the interview did not take the form of an oral questionnaire. The student was permitted to talk freely. The interviewee had nothing to write. Neither did the interviewer attempt to record the information given while the interview was proceeding. However, immediately after the interview the interviewer wrote down all facts learned from the interviewee, which were pertinent to the study.

The interviewer, as he approached each student, endeavored to be friendly, tactful, honest, sincere, straightforward and frank. The interview was started by calling the student by his or her first name or by his or her last name, using Mr., Mrs., or Miss, depending upon the person's age, marital status, and how well he or she was known by the writer. The interviewer than introduced himself if he were not already known by the interviewee. Some conversation was carried on about current topics of interest, such as: Oklahoma State University athletics and other campus activities, weather, courses students were taking, what they were planning to do as a life work, national and world news, home town of the interviewee, and the student's interests (music, hobbies, athletics, and others) obtained from their personal files.

The interviewer would then explain that he was also a student at

Oklahoma State University working on a thesis problem which included interviewing certain college students, the interviewee being one of them. The importance of receiving the student's views was stressed. The interviewee was told that the information he alone could give would be useful in solving a problem of not only local but national importance.

It was anticipated that the group easiest to interview would be made up of students who selected chemistry as a major and persisted. Students in this group had been successful in their pursuit of chemistry, and a more direct approach was used in getting information from them. After rapport had been established the purpose of the interview was more fully explained. A statement such as the following was made, "You are probably aware that the nation faces a critical shortage of scientists, which includes chemists." At this point a graph showing the decline in percentage of chemistry majors at Oklahoma State University was shown. It was pointed out that there have been many guesses about what caused this decline. Now there was a need to learn from the students themselves what they know about the problem: Why is chemistry selected as a major, and why do some students persist and others do not?

The interviewer had in mind that information obtained from the interviewee about selection of chemistry as a major would be classified later among the six categories: factors connected with (1) the college experiences of students, (2) students' experiences with the public and government, (3) the home experiences of students, (4) the secondary school experiences of students, (5) the elementary school experiences of students, and (6) personal factors. These categories were used in the 127-item rating scale sent to land grant college educators. The factors indicated by the responses of the professors to this rating scale served as guides in interviewing and also enabled the writer to compare factors identified in the interviews with those identified by the land grant college professors. Accordingly, the interviewees were encouraged to talk freely to leading questions covering these six categories, which were introduced as follows:

(1) Here in college you have had experiences connected with the chemistry lecturers, laboratory instructors, storeroom employees, advisors, classroom and laboratory facilities, and the like. What specific college experiences do you feel influenced you to select chemistry as a major?

(2) There are many personal factors which may have influenced your decision to major in chemistry. Examples of personal factors include your age, sex, scientific interests and aptitudes, participation in extracurricular and social activities, and ability to express oneself. What personal factors do you feel have been most favorable toward your selection of chemistry as a major?

(3) In your experiences with the government and the general public which involved fellow students, various organizations, chemical industries, scholarships, selective service, and the like, what factors influenced you to select chemistry as a major?

(4) What factors in your home life from the time you can remember to the present do you feel have favored your selection of chemistry as a major?

(5) During your high school days you took some required and some elective courses. You had teachers and counselors with different abilities. Out of all your high school experiences which ones do you think influenced you the most to select chemistry as a major?

(6) What experiences did you have while in grade school which you feel influenced your decision to select chemistry as a major?

At times, in order to get specific information, it was necessary to ask such questions as: "Did you ever receive a chemistry set as a gift? - If so, what influence do you think it had on your selection of chemistry as a major? Are any members of your family chemists? - If so, do you think they influenced you to major in chemistry?" However, the interview did not take the form of a detailed oral questionnaire. The interview was controlled by using leading questions of a broad nature, specific narrow questions when needed, and by tactfully pulling the interviewee back on the subject when necessary by using such remarks as "You were saying . . . ."

Information about persistence in chemistry was considered under three categories: (1) factors connected with the college students' experiences in the classroom and laboratory, (2) personal factors and (3) miscellaneous. Leading questions covering these three categories were introduced as follows:

(1) Out of all your college experiences which ones do you feel have influenced you the most to stay with chemistry as a major?

(2) What personal factors do you feel have favored your persistence in chemistry as a major?

(3) There may be other things which have influenced you to "stick with" chemistry. Can you think of any other factors which you feel have caused you to persist in chemistry?

Again, detailed questions were sometimes necessary to secure specific information about persistence in chemistry.

It was anticipated that the most difficult group to interview would be those students who selected chemistry as a major but did not persist in it. In some instances there were students who failed in chemistry and had to change. In other cases, students may have decided on medicine, dentistry, and the like and felt that they made a better choice than chemistry. The latter were approached directly as were the persistors.

The others who had to change were approached indirectly by such questions as, "You are majoring in psychology - what do you plan to do when you graduate?" The six categories for selection were approached indirectly by applying the leading questions to the interviewee's present major. Leads often arose which were utilized to shift to the time when the student was majoring in chemistry. When no such leads developed, the student was asked, "Are there any other fields in which you once thought you would like to major?" Then his reasons for selecting chemistry were ascertained.

Finally, the following leading questions were asked to obtain information about why the students did not persist in chemistry:

(1) Were there any chemistry classroom or laboratory experiences which caused you to change your major?

(2) Were there any personal factors which caused you to change your major?

(3) What other experiences here at Oklahoma State University or elsewhere do you feel influenced your decision to discontinue a major in chemistry?

The students who elected to take one or more courses in chemistry but did not select it as a major were believed to be the second easiest group to interview. In some cases the student did not make a good grade in chemistry and had to be approached like those who selected chemistry but did not persist. Others had made satisfactory grades in chemistry and could be approached more directly. Those who did not do so well in chemistry were questioned about their present major, how they were getting along, what their future plans were, and what reasons they felt accounted for their choice of major. Then the interview turned to the following: "At one time you voluntarily chose to take chemistry 114 (and other chemistry courses, if taken) here at Oklahoma State University. What do you feel influenced you to enroll in the course(s)? Is there anything in your college experiences that may have caused you to discontinue enrolling in chemistry?" This last question was reworded to include personal factors, experiences with the government and general public, home experiences, high school and grade school experiences which might have influenced the choice of "no more chemistry."

When the interviewer had obtained all information desired, the interview was terminated by him. Appreciation was expressed to the interviewee for his assistance. Well-wishes were given for the student's success in the rest of his college work and in his chosen vocation.

The anticipated degrees of difficulty for interviewing the three different groups of students did not materialize. It was the writer's experience that all were easy to interview. He could not have wished for better cooperation from the students.

CHAPTER V

RESULTS OF STUDY

This study was concerned with three basic purposes: The identification of factors, or patterns of factors, associated with (1) selection of and (2) persistence in chemistry as an area of specialization by Oklahoma State University undergraduates and (3) the designing of a procedure which would result in the actual identification of the factors. To fulfill these purposes the data were summarized and comparisons were made as follows:

(1) The summary of the answers obtained from the graduates to the 45-item rating scale was compared with that obtained from the land grant college professors to the same items in the 127-item scale.

(2) The summaries of the answers obtained from the persistors, non-persistors, and non-selectors among the graduates were compared.

(3) The collation and summaries of factors obtained from the interviews of currently enrolled persistors, non-persistors, and non-selectors were compared.

(4) The summary of factors obtained from the entire group of currently enrolled interviewees was compared with the summary obtained from the land grant educators.

(5) The summary of the answers obtained from the graduates was compared with the summary of factors obtained from the interviewees.

(6) Finally, the summaries of the answers obtained from the grad-

uates, currently enrolled students, and professors of land grant colleges were compared.

Results from the Inquiry to Graduates of Oklahoma State University

In all, thirty-five graduates of Oklahoma State University filled in the 45-item rating scales and returned them. In Table XI a summary of the number of replies returned is shown.

TABLE XI

TABULAR SUMMARY OF THE NUMBER OF REPLIES FROM GRADUATES OF OKLAHOMA STATE UNIVERSITY

Groups	Number of Graduates to Whom Rating Scales Were Sent	Number of Replies from Graduates	Per cent of Graduates Responding
Persistors	28	13	46%
Non-Persistors	26	13	50%
Non-Selectors	32	9	28%
Totals	86	35	41%

The procedure used in summarizing the graduates' ratings was the same as that used for the 127-item rating scale. A frequency count was made and weighted scores were calculated. The items were then arranged in order of algebraic decrease of values for weighted scores and a rank was given to each. Some items had the same score and therefore the same rank. A tabular summary of the rating frequency, weighted score, and rank of each item in the 45-item rating scale is shown in Appendix I.

The maximum score possible for any item, had all thirty-five graduates checked "always," would have been (+70). The minimum score would have been (-70). Had all thirty-five checked "usually" a score of (+35) would have been realized, and if they had all checked "seldom," a score of (-35). If they had all checked "occasionally," the score would have been zero. The theoretical scores, then, if all thirty-five had checked the same space, are: (+70), (+35), (0), (-35), (-70). This is a discrete scale, and actually a continuous series is involved. (0) really represents an interval (-17 to +17). Therefore, from the highest to the lowest scores the terms "always," "usually," "occasionally," "seldom," and "never" would be represented by the following intervals, respectively: (+87 to +53), (+52 to +18), (+17 to -17), (-18 to -52), and (-53 to -87).

No item in the 45-item rating scale was considered by graduates as always favoring the selection of chemistry. Items with rank order numbers one to fifteen, inclusive, usually favor selection. Those with numbers sixteen to twenty-three, inclusive, occasionally favor selection. Items with numbers twenty-four to twenty-eight, inclusive, seldom favor selection of chemistry. No factor in the list never favors selection, according to the opinions of graduates.

No item was considered by graduates as always favoring persistence in chemistry. Items with rank order numbers one to seven, inclusive, usually favor persistence. Items eight to thirteen occasionally favor persistence in chemistry. Four items, numbers fourteen to seventeen, inclusive, seldom favor persistence. No item in the list never favors persistence, according to graduates of Oklahoma State University.

Comparison of Results from Graduate
Replies with Those of Replies from
Land Grant College Educators

In order to compare results of graduate replies with those of replies from professors in land grant colleges, the forty-five items used in the rating scale sent to graduates were ranked in accordance with the weighted scores calculated from returns of graduates. Likewise, the same forty-five items selected from the 127-item scale were re-ranked in descending order according to the weighted scores calculated from returns of land grant college professors. Then the rankings given by the two groups to the various items of the forty-five-item scale were compared by calculating rank order coefficients of correlation between them. In addition, a rating of "always," "usually," "occasionally," "seldom," or "never" favoring selection of or persistence in chemistry was assessed each item, depending upon its weighted score in comparison with the weighted score intervals for the five ratings. These intervals were different for the 45-item and the 127-item scales because the number of respondents to the two scales differed. In Appendix F the rankings and ratings by land grant college professors and graduates of factors alleged to be associated with selection of and persistence in chemistry by students are given.

Table XII shows a comparison, based upon results received from both graduates and land grant college professors, of the rankings and ratings for twenty-eight factors alleged to be associated with selection of chemistry by undergraduates.

A rank order coefficient of correlation was computed for the rankings given the twenty-eight items by graduates of Oklahoma State University

TABLE XII

COMPARISON OF RANKINGS AND RATINGS BY GRADUATES OF OKLAHOMA STATE UNIVERSITY AND THOSE BY LAND GRANT COLLEGE PROFESSORS OF TWENTY-EIGHT FACTORS ALLEGED TO BE ASSOCIATED WITH SELECTION OF CHEMISTRY BY UNDERGRADUATES

Item No. in 45-Item Scale	Weighted Score, Ranking, and Rating of Land Grant College Professors			Weighted Score, Ranking, and Rating of Graduates of Oklahoma State University		
	Weighted Score	Ranking	Rating	Weighted Score	Ranking	Rating
1	-8	17	Occasionally	-10	19	Occasionally
2	+32	14½	Usually	+9	16	Occasionally
3	-13	22½	Occasionally	-18	24	Seldom
4	+45	6	Usually	+23	11	Usually
5	+35	13	Usually	+20	13	Usually
6	-12	20½	Occasionally	+1	17	Occasionally
7	+38	10½	Usually	+34	4½	Usually
8	+39	9	Usually	+19	14	Usually
9	+31	16	Usually	+29	8	Usually
10	+32	14½	Usually	+24	10	Usually
11	+37	12	Usually	+30	7	Usually
12	+38	10½	Usually	+26	9	Usually
13	-17	25	Occasionally	-23	26½	Seldom
14	+47	5	Usually	+34	4½	Usually
15	+44	7	Usually	+35	3	Usually
16	-18	26½	Occasionally	-17	23	Occasionally
17	-16	24	Occasionally	-21	25	Seldom
18	+54	2	Usually	+21	12	Usually

Table XII (continued)

Item No. in 45-Item Scale	Weighted Score, Ranking, and Rating of Land Grant College Professors			Weighted Score, Ranking, and Rating of Graduates of Oklahoma State University		
	Weighted Score	Ranking	Rating	Weighted Score	Ranking	Rating
19	-11	19	Occasionally	-15	21½	Occasionally
20	-20	28	Seldom	-30	28	Seldom
21	-10	18	Occasionally	-15	21½	Occasionally
22	+48	4	Usually	+18	15	Usually
23	-12	20½	Occasionally	-1	18	Occasionally
24	-13	22½	Occasionally	-23	26½	Seldom
25	+58	1	Always	+45	1	Usually
26	+53	3	Usually	+43	2	Usually
27	+40	8	Usually	+32	6	Usually
28	-18	26½	Occasionally	-11	20	Occasionally

and land grant college professors. When the formula $\rho = 1 - \frac{6 \Sigma D^2}{N(N^2 - 1)}$ is used, $\rho = 0.85$. The number of degrees of freedom for the twenty-eight items is twenty-six. The correlation coefficient at the 1% level of significance is 0.478. The computed rho of 0.85 is considerably larger than 0.478 and hence is statistically significant at the 0.01 level. Accordingly, the agreement between graduates and land grant college professors is the result of something more than chance.

The opinion of land grant college educators was that "scientific interests of students" always favored selection of chemistry, whereas graduates agreed that this factor usually favored selection. However, this item had rank order number one for both groups of respondents.

With one exception, graduates and land grant college educators agreed that the following items usually favor selection:

2. Efforts made from the fifth through the eighth grade to detect and encourage students with science talent to select science and mathematics courses in high school.

4. Adequacy of science taught in the secondary schools.

5. Adequacy of mathematics taught in the secondary schools.

7. Students' having had chemistry in high school.

8. Attitudes of high school counselors toward the pursuit of chemistry.

9. Training of physics, biology, and general science teachers in the secondary schools.

10. Academic qualifications of high school chemistry teachers.

11. Quality of the background in chemistry obtained by high school students.

12. Efforts made to detect and encourage college-bound students with science talent to select chemistry in college.

14. Friendly and helpful attitudes on the part of college chemistry teachers toward their freshman students.

15. Training of college chemistry teachers.

18. Abilities of freshman chemistry teachers to inspire students.

22. Abilities of professors to gear instruction in the theory of general chemistry to the level of beginning students.

26. Scientific aptitudes of students.

27. General intelligence of students.

The exception was "efforts made from the fifth through the eighth grade to detect and encourage students with science talent to select science and mathematics courses in high school." This was said to <u>occasionally</u> favor selection by graduates, but it had the highest score in the group of factors rated occasionally by them.

With four exceptions graduates and land grant college professors agreed that the following items occasionally favor selection:

1. Moderate size of classes in elementary schools.

3. Adequacy of English courses taught in the secondary schools.

6. Students' having had biology in high school.

13. Extension of the high school academic year to ten or eleven months.

16. Abilities of freshman chemistry teachers to inspire students.

17. Conflict between chemistry course schedules and jobs essential to students' staying in college.

19. Attitudes of chemistry storeroom employees toward students.

21. Extent to which students participate in extra-curricular activities.

23. Amount of emphasis in general chemistry on the cultural aspects of chemistry.

24. Extent of participation in social activities by students while attending college.

28. Age of students.

The four exceptions which graduates rated seldom instead of occasionally were: "adequacy of English courses taught in the secondary schools," "extension of the high school academic year to ten or eleven months," "conflict between chemistry course schedules and jobs essential to students' staying in college," and "extent of participation in social activities by students while attending college."

Both graduates and land grant college professors agreed that "low departmental standards for majoring in chemistry" seldom favored selection. This was somewhat of a surprise. It was thought that perhaps students would agree that if the chemistry department lowered standards, more students would select chemistry as their major. It is interesting to note that both graduates and land grant college educators put this at the very bottom of the list in order of rank number. Evidently, students would not want to major in the field of chemistry and feel they were being inadequately prepared to do the work for which the degree entitled them.

Table XIII shows a comparison, based upon results received from both graduates and land grant college professors, of the rankings and ratings for seventeen factors alleged to be associated with persistence in chemistry by undergraduates. A rank order coefficient of correlation was computed for the rankings given the seventeen items by graduates of Oklahoma State University and land grant college professors. When the formula $\rho = 1 - \frac{6 \sum D^2}{N(N^2 - 1)}$ is used, $\rho = 0.89$. The number of degrees of freedom for the seventeen items is fifteen. The correlation coefficient at the 1% level of significance is 0.606. The computed rho of 0.89 is considerably larger than 0.606 and hence is statistically significant at the 0.01 level. Accordingly, the agreement between graduates and land grant college educators is the result of something more than chance.

The opinion of land grant college professors was that two factors: "abilities of chemistry professors to inspire students" and "scientific aptitudes of students" always favor persistence in chemistry. Graduates said these two factors usually favor persistence.

With two exceptions, graduates and land grant college educators agreed that the following items usually favor persistence:

1. Adequacy of advisement for chemistry students after selection of chemistry as their major.

6. Friendly and helpful attitudes on the part of chemistry professors toward their students.

8. The degree to which brilliant chemistry students are challenged to do the best of which they are capable.

9. Abilities of professors to gear instruction in the theory of general chemistry to the level of the beginning student.

10. Training of chemistry professors in chemistry.

TABLE XIII

COMPARISON OF RANKINGS AND RATINGS BY GRADUATES OF OKLAHOMA STATE UNIVERSITY AND THOSE BY LAND GRANT COLLEGE PROFESSORS OF SEVENTEEN FACTORS ALLEGED TO BE ASSOCIATED WITH PERSISTENCE IN CHEMISTRY BY UNDERGRADUATES

Item No. in 45-Item Scale	Weighted Score, Ranking, and Rating of Land Grant College Professors			Weighted Score, Ranking, and Rating of Graduates of Oklahoma State University		
	Weighted Score	Ranking	Rating	Weighted Score	Ranking	Rating
1	+36	8	Usually	+27	7	Usually
2	-11	11	Occasionally	-7	12	Occasionally
3	-20	15	Seldom	+3	10	Occasionally
4	-10	10	Occasionally	-30	15½	Seldom
5	+58	1	Always	+34	4½	Usually
6	+50	3	Usually	+35	2½	Usually
7	-18	14	Occasionally	-3	11	Occasionally
8	+37	7	Usually	+29	6	Usually
9	+43	5½	Usually	+15	8	Occasionally
10	+43	5½	Usually	+34	4½	Usually
11	-17	12½	Occasionally	-20	14	Seldom
12	-25	16	Seldom	-30	15½	Seldom
13	-32	17	Seldom	-37	17	Seldom
14	+31	9	Usually	+11	9	Occasionally
15	-17	12½	Occasionally	-17	13	Occasionally
16	+57	2	Always	+45	1	Usually
17	+46	4	Usually	+35	2½	Usually

14. Adequacy of equipment in college chemistry laboratories.

17. General intelligence of students.

The two exceptions were "abilities of professors to gear instruction in the theory of general chemistry to the level of the beginning student" and "adequacy of equipment in college chemistry laboratories." These were said to occasionally favor persistence by graduates.

With one exception, graduates and land grant college professors agreed that the following items occasionally favor persistence:

2. Emphasis on the disciplinary aspects in courses in general chemistry.

3. Emphasis on the cultural aspects in courses in general chemistry.

7. Attitudes of chemistry storeroom employees toward students.

15. Conflict between chemistry course schedules and jobs essential to students' staying in college.

The exception was "emphasis on the cultural aspects in courses in general chemistry." This, according to land grant college professors, seldom favors persistence.

With two exceptions, graduates and land grant college educators agreed that the following items seldom favor persistence:

4. Degree of students' physical handicaps.

11. Necessity of spending three hours in chemistry laboratory work per week for one semester-hour credit.

12. Safety records in college chemistry laboratories.

13. Policies about breakage costs in chemistry laboratory work.

The two exceptions were "degree of students' physical handicaps" and "necessity of spending three hours in chemistry laboratory work per week for one semester-hour credit." These were said to occasionally favor persistence by land grant college educators. Both groups checking the rating scales placed "policies about breakage costs in chemistry laboratory work" at the very bottom of the list in order of rank number.

Comparison of the Results Among the Three Groups of Graduates that responded: the Persistors, Non-persistors, and Non-selectors

Comparison of the results among the three groups of graduates was made by tabulating the items about selection in order of decreasing weighted score for each of the three groups. Then a rank was assigned to each item in accordance with its score. Also, a rating of "always," "usually," "occasionally," "seldom," and "never" favoring selection of chemistry was assessed each item, depending upon its weighted score in comparison with the weighted score intervals for the five ratings. For the thirteen persistors and thirteen non-persistors, the highest to the lowest scores for the terms "always" to "never" would be represented by the following intervals, respectively: (+32 to +20), (+19 to +7), (+6 to -6), (-7 to -19), and -20 to -32). For the nine non-selectors the intervals would be (+22 to +14), (+13 to +5), (+4 to -4), (-5 to -13), (-14 to -22) for "always" to "never," respectively. Table XIV shows these scores, rankings, and ratings by groups. In Table XIV, letters A, U, O, S, and N have been used for the ratings "always," "usually," "occasionally," "seldom," and "never," respectively.

Finally, rank order coefficients of correlation were computed between persistors and non-persistors (rho 1, 2), persistors and non-selectors (rho 1, 3), and non-persistors and non-selectors (rho 2, 3). Table XV shows these rhos.

All of the computed rhos are larger than the correlation coefficient of 0.478 at the 1% level of significance. Hence, they are statistically significant at the 0.01 level. The agreement among groups

TABLE XIV

COMPARISON OF RANKINGS AND RATINGS AMONG THE THREE GROUPS OF OKLAHOMA STATE UNIVERSITY GRADUATES, PERSISTORS, NON-PERSISTORS, AND NON-SELECTORS, OF TWENTY-EIGHT FACTORS ALLEGED TO BE ASSOCIATED WITH SELECTION OF CHEMISTRY BY UNDERGRADUATES

Item No.	Thirteen Persistors			Thirteen Non-Persistors			Nine Non-Selectors		
	Weighted Score	Ranking	Rating	Weighted Score	Ranking	Rating	Weighted Score	Ranking	Rating
1	-3	18.5	0	-6	23	0	-1	20.5	0
2	+4	16	0	+2	18	0	+3	15	0
3	-6	23	0	-10	25.5	S	-4	25	0
4	+8	11	U	+8	12	U	+8	6	U
5	+6	14.5	0	+6	14	0	+8	6	U
6	-4	20	0	+5	15.5	0	0	18.5	0
7	+9	8	U	+15	4.5	U	+10	1.5	U
8	+6	14.5	0	+8	12	U	+5	12.5	U
9	+9	8	U	+12	6	U	+7	9.5	U
10	+12	5	U	+9	9.5	U	+3	15	0
11	+11	6	U	+10	7.5	U	+8	6	U
12	+8	11	U	+8	12	U	+8	6	U
13	-10	26	S	-10	25.5	S	0	18.5	0
14	+14	4	U	+15	4.5	U	+7	9.5	U
15	+15	3	U	+10	7.5	U	+10	1.5	U
16	-5	21.5	0	-13	27.5	S	+1	17	0
17	-12	28	S	-4	21.5	0	-5	27	S
18	+7	13	U	+9	9.5	U	+5	12.5	U
19	-9	24	S	-2	19.5	0	-4	25	0
20	-10	26	S	-13	27.5	S	-7	28	S
21	-5	21.5	0	-2	19.5	0	-4	25	0
22	+9	8	U	+4	17	0	+3	15	0
23	-1	17	0	+5	15.5	0	-3	23	0
24	-10	26	S	-8	24	S	-1	20.5	0
25	+20	1	A	+18	1	U	+9	3	U
26	+19	2	U	+17	2	U	+8	6	U
27	+82	11	U	+16	3	U	+6	11	U
28	-3	18.5	0	-4	21.5	0	-2	22	0

of graduates is the result of something more than chance. However, because of the limited number of the population among the three groups, any inference based on differences among the three computed rhos would be a very precarious one.

TABLE XV

COMPARISON OF RANK ORDER COEFFICIENTS OF CORRELATION AMONG THE FOLLOWING GROUPS OF OKLAHOMA STATE UNIVERSITY GRADUATES: PERSISTORS AND NON-PERSISTORS, PERSISTORS AND NON-SELECTORS, NON-PERSISTORS AND NON-SELECTORS FOR RANKINGS OF TWENTY-EIGHT ITEMS ABOUT SELECTION OF CHEMISTRY

Groups Compared	Computed Rho
Persistors and Non-persistors	0.904
Persistors and Non-selectors	0.850
Non-persistors and Non-selectors	0.810

For the three groups of graduates, the same rating was assessed to seventeen of the twenty-eight items dealing with selection of chemistry. They were all of the opinion that the following items usually favor selection of chemistry:

4. Adequacy of science taught in the secondary schools.

7. Students' having had chemistry in high school.

9. Training of physics, biology, and general science teachers in the secondary schools.

11. Quality of the background in chemistry obtained by high school students.

12. Efforts made to detect and encourage college-bound students with science talent to select chemistry in college.

14. Friendly and helpful attitudes on the part of college chemistry teachers toward their freshman students.

15. Training of college chemistry teachers.

18. Abilities of freshman chemistry teachers to inspire students.

26. Scientific aptitudes of students.

27. General intelligence of students.

In addition, they were all of the opinion that the following items occasionally favor selection of chemistry:

1. Moderate size of classes in elementary schools.

2. Efforts made from the fifth through the eighth grade to detect and encourage students with science talent to select science and mathematics courses in high school.

6. Students' having had biology in high school.

21. Extent to which students participate in extra-curricular activities.

23. Amount of emphasis in general chemistry on the cultural aspects of chemistry.

28. Age of students.

Also, they were of the opinion that the following item seldom favors selection of chemistry:

20. Low departmental standards for majoring in chemistry.

The remaining twenty-eight items had ratings which did not differ beyond adjacent ratings. A particular factor was either rated by all three groups as "always-usually," "usually-occasionally," or "occasionally-seldom" favoring selection. None of the groups agreed that any of the remaining eleven factors never favored selection of chemistry. Two of the three groups were of the opinion that the following items usually favor selection of chemistry:

8. Attitudes of high school counselors toward the pursuit of chemistry.

10. Academic qualifications of high school chemistry teachers.

25. Scientific interests of students.

In addition, two groups were of the opinion that the following items occasionally favor selection:

3. Adequacy of English courses taught in the secondary schools.

5. Adequacy of mathematics taught in the secondary schools.

16. Safety records in college chemistry laboratories.

19. Attitudes of chemistry storeroom employees toward students.

22. Abilities of professors to gear instruction in the theory of general chemistry to the level of beginning students.

Also, two groups were of the opinion that the following items seldom favor selection:

13. Extension of the high school academic year to ten or eleven months.

17. Conflict between chemistry course schedules and jobs essential to students' staying in college.

24. Extent of participation in social activities by students while attending college.

Likewise, the weighted scores, rankings, and ratings by groups for items about persistence were tabulated as shown in Table XVI.

Also, rank order coefficients of correlation were computed between persistors and non-persistors (rho 1, 2), persistors and non-selectors (rho 1, 3), and non-persistors and non-selectors (rho 2, 3). Table XVII shows these rhos.

All of the computed rhos are larger than the correlation coefficient of 0.606 at the 1% level of significance. Hence, they are statistically significant at the 0.01 level. The agreement among the groups of graduates is the result of something more than chance. However, because of the limited number of the population among the three groups, any inference based on differences among the three computed rhos would be a very precarious one.

TABLE XVI

COMPARISON OF RANKINGS AND RATINGS AMONG THE THREE GROUPS OF OKLAHOMA STATE UNIVERSITY GRADUATES, PERSISTORS, NON-PERSISTORS, AND NON-SELECTORS, OF SEVENTEEN FACTORS ALLEGED TO BE ASSOCIATED WITH PERSISTENCE IN CHEMISTRY BY UNDERGRADUATES

Item No.	Thirteen Persistors			Thirteen Non-Persistors			Nine Non-Selectors		
	Weighted Score	Ranking	Rating	Weighted Score	Ranking	Rating	Weighted Score	Ranking	Rating
1	+10	6.5	U	+13	3.5	U	+4	7	0
2	-3	12	0	-1	11	0	-3	12.5	0
3	+1	10	0	+3	10	0	-1	11	0
4	-15	16.5	S	-10	15	S	-5	15	S
5	+16	2.5	U	+13	3.5	U	+6	6	U
6	+16	2.5	U	+11	5.5	U	+8	3	U
7	-1	11	0	-2	12	0	0	10	0
8	+10	6.5	U	+11	5.5	U	+8	3	U
9	+7	8	U	+7	8.5	U	+1	9	0
10	+15	4	U	+10	7	U	+9	1	U
11	-7	13	S	-4	13	0	-9	16	S
12	-13	15	S	-13	17	S	-4	14	0
13	-15	16.5	S	-12	16	S	-11	17	S
14	+3	9	0	+7	8.5	U	+2	8	0
15	-9	14	S	-6	14	0	-3	12.5	0
16	+20	1	A	+17	1	U	+8	3	U
17	+12	5	U	+16	2	U	+7	5	U

TABLE XVII

COMPARISON OF RANK ORDER COEFFICIENTS OF CORRELATION AMONG THE FOLLOWING GROUPS OF OKLAHOMA STATE UNIVERSITY GRADUATES: PERSISTORS AND NON-PERSISTORS, PERSISTORS AND NON-SELECTORS, NON-PERSISTORS AND NON-SELECTORS FOR RANKINGS OF SEVENTEEN ITEMS ABOUT PERSISTENCE IN CHEMISTRY

Groups Compared	Computed Rho
Persistors and Non-persistors	0.942
Persistors and Non-selectors	0.930
Non-persistors and Non-selectors	0.866

For the three groups of graduates, the same rating was assessed to ten of the seventeen items dealing with persistence in chemistry. They were all of the opinion that the following items usually favor persistence in chemistry:

5. Abilities of chemistry professors to inspire students.

6. Friendly and helpful attitudes on the part of chemistry professors toward their students.

8. The degree to which brilliant chemistry students are challenged to do the best of which they are capable.

10. Training of chemistry professors in chemistry.

17. General intelligence of students.

In addition, they were all of the opinion that the following items occasionally favor persistence:

2. Emphasis on the disciplinary aspects in courses in general chemistry.

3. Emphasis on the cultural aspects in courses in general chemistry.

7. Attitudes of chemistry storeroom employees toward students.

Also, they were of the opinion that the following items seldom favor persistence:

4. Degree of students' physical handicaps.

13. Policies about breakage costs in chemistry laboratory work.

The remaining seven items had ratings which did not differ beyond adjacent ratings. A particular factor was either rated by all three groups as "always-usually," "usually-occasionally," or "occasionally-seldom" favoring persistence. None of the groups agreed that any of the remaining seven factors never favored persistence in chemistry. Two of the three groups were of the opinion that the following items always favor persistence:

1. Adequacy of advisement for chemistry students after selection of chemistry as their major.

9. Abilities of professors to gear instruction in the theory of general chemistry to the level of the beginning student.

16. Scientific aptitudes of students.

In addition, two groups were of the opinion that the following items occasionally favor persistence:

14. Adequacy of equipment in college chemistry laboratories.

15. Conflict between chemistry course schedules and jobs essential to students' staying in college.

Also, two groups were of the opinion that the following items seldom favor persistence:

11. Necessity of spending three hours in chemistry laboratory work per week for one semester-hour credit.

12. Safety records in college chemistry laboratories.

Comparison of Results Among the Land Grant College Professors, Persistors, Non-Persistors, and Non-Selectors on the 45-Item Rating Scale

Comparison of the results among the land grant college professors, persistors, non-persistors, and non-selectors on the 45-item rating scale was made by tabulating the items about selection and persistence in separate tables, showing the rank and rating for each item by the four groups. Then agreements and differences in the ratings by the four groups were noted and summarized. Table XVIII shows the rankings and ratings of items about selection of chemistry for land grant college professors and the three groups of graduates.

There was complete agreement in ratings among these four groups on fifteen out of twenty-eight factors dealing with selection of chemistry. They all believed that items numbered 4, 7, 9, 11, 12, 14, 15, 18, 26, 27 usually favor selection of chemistry as a major. These items, with their numbers, are as follows:

4. Adequacy of science taught in the secondary schools.

7. Students' having had chemistry in high school.

9. Training of physics, biology, and general science teachers in the secondary schools.

11. Quality of the background in chemistry obtained by high school students.

12. Efforts made to detect and encourage college-bound students with science talent to select chemistry in college.

14. Friendly and helpful attitudes on the part of college chemistry teachers toward their freshman students.

15. Training of college chemistry teachers.

18. Abilities of freshman chemistry teachers to inspire students.

26. Scientific aptitudes of students.

27. General intelligence of students.

They all agreed that the following occasionally favor selection of chemistry:

1. Moderate size of classes in elementary schools.

6. Students' having had biology in high school.

TABLE XVIII

COMPARISON OF RANKINGS AND RATINGS AMONG LAND GRANT COLLEGE PROFESSORS AND THE THREE GROUPS OF OKLAHOMA STATE UNIVERSITY GRADUATES, PERSISTORS, NON-PERSISTORS, AND NON-SELECTORS, OF TWENTY-EIGHT FACTORS ALLEGED TO BE ASSOCIATED WITH SELECTION OF CHEMISTRY BY UNDERGRADUATES

Item No.	Land Grant College Professors		Persistors		Non-Persistors		Non-Selectors	
	Rank	Rating	Rank	Rating	Rank	Rating	Rank	Rating
1	17	Occasionally	18.5	Occasionally	23	Occasionally	20.5	Occasionally
2	14½	Usually	16	Occasionally	18	Occasionally	15	Occasionally
3	22½	Occasionally	23	Occasionally	25.5	Seldom	25	Occasionally
4	6	Usually	11	Usually	12	Usually	6	Usually
5	13	Usually	14.5	Occasionally	14	Occasionally	6	Usually
6	20½	Occasionally	20	Occasionally	15.5	Occasionally	18.5	Occasionally
7	10½	Usually	8	Usually	4.5	Usually	1.5	Usually
8	9	Usually	14.5	Occasionally	12	Usually	12.5	Usually
9	16	Usually	8	Usually	6	Usually	9.5	Usually
10	14½	Usually	5	Usually	9.5	Usually	15	Occasionally
11	12	Usually	6	Usually	7.5	Usually	6	Usually
12	10½	Usually	11	Usually	12	Usually	6	Usually
13	25	Occasionally	26	Seldom	25.5	Seldom	18.5	Occasionally

Table XVIII (continued)

Item No.	Land Grant College Professors		Persistors		Non-Persistors		Non-Selectors	
	Rank	Rating	Rank	Rating	Rank	Rating	Rank	Rating
14	5	Usually	4	Usually	4.5	Usually	9.5	Usually
15	7	Usually	3	Usually	7.5	Usually	1.5	Usually
16	26½	Occasionally	21.5	Occasionally	27.5	Seldom	17	Occasionally
17	24	Occasionally	28	Seldom	21.5	Occasionally	27	Seldom
18	2	Usually	13	Usually	9.5	Usually	12.5	Usually
19	19	Occasionally	24	Seldom	19.5	Occasionally	25	Occasionally
20	28	Seldom	26	Seldom	27.5	Seldom	28	Seldom
21	18	Occasionally	21.5	Occasionally	19.5	Occasionally	25	Occasionally
22	4	Usually	8	Usually	17	Occasionally	15	Occasionally
23	20½	Occasionally	17	Occasionally	15.5	Occasionally	23	Occasionally
24	22½	Occasionally	26	Seldom	24	Seldom	20.5	Occasionally
25	1	Always	1	Always	1	Usually	3	Usually
26	3	Usually	2	Usually	2	Usually	6	Usually
27	8	Usually	11	Usually	3	Usually	11	Usually
28	26½	Occasionally	18.5	Occasionally	21.5	Occasionally	22	Occasionally

21. Extent to which students participate in extra-curricular activities.

23. Amount of emphasis in general chemistry on the cultural aspects of chemistry.

28. Age of students.

They were all in agreement that one factor seldom favors selection of chemistry. It was:

20. Low departmental standards for majoring in chemistry.

For the other thirteen factors in the list of twenty-eight dealing with selection, there was no disagreement beyond adjacent ratings. A particular factor was either rated by all the groups as "always-usually" or "usually-occasionally" or "occasionally-seldom" favoring selection. None of the groups said than any of the remaining thirteen factors never favored selection of chemistry. A majority (three to one) of the groups were of the opinion that the following factors usually favor selection:

8. Attitudes of high school counselors toward the pursuit of chemistry. (The persistors rated this occasionally.)

10. Academic qualifications of high school chemistry teachers. (The non-selectors rated this occasionally.)

A majority agreed that the following occasionally favor selection:

2. Efforts made from the fifth through the eighth grade to detect and encourage students with science talent to select science and mathematics courses in high school. (The land grant college professors rated this usually.)

3. Adequacy of English courses taught in the secondary schools. (The non-persistors rated this seldom.)

16. Safety records in college chemistry laboratories. (The non-persistors rated this seldom.)

19. Attitudes of chemistry storeroom employees toward students. (The persistors rated this seldom.)

There was a split decision for the following six factors:

5. Adequacy of mathematics taught in the secondary schools. (The

land grant college experts and non-selectors rated this usually; the other two groups rated it occasionally.)

13. Extension of the high school academic year to ten or eleven months. (The land grant college educators and non-selectors rated this occasionally; the other two groups rated it seldom.)

17. Conflict between chemistry course schedules and jobs essential to students' staying in college. (The land grant college professors and non-persistors rated this occasionally; the other two groups rated it seldom.)

22. Abilities of professors to gear instruction in the theory of general chemistry to the level of beginning students. (The land grant college professors and persistors rated this usually; the other two groups rated it occasionally.)

24. Extent of participation in social activities by students while attending college. (The land grant college educators and non-persistors rated this occasionally; the other two groups rated it seldom.)

25. Scientific interests of students. (The land grant college teachers and persistors rated this always; the other two groups rated it usually.)

For the above six factors the land grant college professors always gave the factor the higher rating. In two instances non-selectors agreed with them; in two instances non-persistors agreed with them; and in two instances persistors agreed with them.

Table XIX shows the rankings and ratings of items about persistence in chemistry for land grant college professors and the three groups of graduates. There was complete agreement among the four groups on six of seventeen items dealing with persistence. They all believed that the following factors usually favor persistence in chemistry:

6. Friendly and helpful attitudes on the part of chemistry professors toward their students.

8. The degree to which brilliant chemistry students are challenged to do the best of which they are capable.

10. Training of chemistry professors in chemistry.

17. General intelligence of students.

They all agreed that the following factors occasionally favor persistence:

TABLE XIX

COMPARISON OF RANKINGS AND RATINGS AMONG LAND GRANT COLLEGE PROFESSORS AND THE THREE GROUPS OF OKLAHOMA STATE UNIVERSITY GRADUATES, PERSISTORS, NON-PERSISTORS, AND NON-SELECTORS, OF SEVENTEEN FACTORS ALLEGED TO BE ASSOCIATED WITH PERSISTENCE IN CHEMISTRY BY UNDERGRADUATES

Item No.	Land Grant College Professors		Persistors		Non-Persistors		Non-Selectors	
	Rank	Rating	Rank	Rating	Rank	Rating	Rank	Rating
1	8	Usually	6.5	Usually	3.5	Usually	7	Occasionally
2	11	Occasionally	12	Occasionally	11	Occasionally	12.5	Occasionally
3	15	Seldom	10	Occasionally	10	Occasionally	11	Occasionally
4	10	Occasionally	16.5	Seldom	15	Seldom	15	Seldom
5	1	Always	2.5	Usually	3.5	Usually	6	Usually
6	3	Usually	2.5	Usually	5.5	Usually	3	Usually
7	14	Occasionally	11	Occasionally	12	Occasionally	10	Occasionally
8	7	Usually	6.5	Usually	5.5	Usually	3	Usually
9	5½	Usually	8	Usually	8.5	Usually	9	Occasionally
10	5½	Usually	4	Usually	7	Usually	1	Usually

Table XIX (continued)

Item No.	Land Grant College Professors		Persistors		Non-Persistors		Non-Selectors	
	Rank	Rating	Rank	Rating	Rank	Rating	Rank	Rating
11	12½	Occasionally	13	Seldom	13	Occasionally	16	Seldom
12	16	Seldom	15	Seldom	17	Seldom	14	Occasionally
13	17	Seldom	16.5	Seldom	16	Seldom	17	Seldom
14	9	Usually	9	Occasionally	8.5	Usually	8	Occasionally
15	12½	Occasionally	14	Seldom	14	Occasionally	12.5	Occasionally
16	2	Always	1	Always	1	Usually	3	Usually
17	4	Usually	5	Usually	2	Usually	5	Usually

2. Emphasis on the disciplinary aspects in courses in general chemistry.

7. Attitudes of chemistry storeroom employees toward students.

They all agreed that the following factor seldom favors persistence:

13. Policies about breakage costs in chemistry laboratory work.

For the other ten factors in the list of seventeen dealing with persistence, there was no disagreement beyond adjacent ratings. A majority of the groups were of the opinion that the following factors usually favor persistence in chemistry:

1. Adequacy of advisement for chemistry students after selection of chemistry as their major. (The non-selectors rated this occasionally.)

5. Abilities of chemistry professors to inspire students. (The land grant college professors rated this always.)

9. Abilities of professors to gear instruction in the theory of general chemistry to the level of the beginning student. (The non-selectors rated this occasionally.)

A majority agreed that the following occasionally favor persistence:

3. Emphasis on the cultural aspects in courses in general chemistry. (The land grant college professors rated this seldom.)

15. Conflict between chemistry course schedules and jobs essential to students' staying in college. (The persistors rated this seldom.)

A majority were of the opinion that the following seldom favor persistence:

4. Degree of students' physical handicaps. (The land grant college professors rated this occasionally.)

12. Safety records in college chemistry laboratories. (The non-selectors rated this occasionally.)

There was a split decision for the following three factors:

11. Necessity of spending three hours in chemistry laboratory work per week for one semester-hour credit. (The land grant college teachers and non-persistors rated this occasionally; the other two groups rated it seldom.)

14. Adequacy of equipment in college chemistry laboratories. (The land grant college professors and non-persistors rated this usually;

the other two groups rated it occasionally.)

16. Scientific aptitudes of students. (The land grant college educators and persistors rated this always; the other two groups rated it usually.)

None of the groups were of the opinion that any of the seventeen factors never favored persistence.

Free Responses of Graduates Included in the 45-Item Rating Scale

The thirty-five graduates told why they did or did not select chemistry as an area of specialization and if they did select it, why they did or did not persist in it. Also, they suggested ways of improving the department of chemistry at Oklahoma State University. A complete list of comments made by persistors, non-persistors, and non-selectors is given in Appendix J. A frequency count was made for the factors mentioned by graduates as favoring selection of and persistence in chemistry.

Responses Concerning Selection

Seven persistors, six non-persistors, and four non-selectors had vocations other than being a chemist in mind when they took college chemistry. For example, one student wrote, "I chose to major in chemistry not for the pure love of this field but because I wanted to obtain a degree in a scientific field before entering a professional (dental) school. Three persistors and four non-persistors mentioned that a good course in high school chemistry contributed to their selection of chemistry as a major. A typical reply follows: "I selected chemistry as a major because of an interesting and successful high school course in chemistry." Three persistors and one non-persistor mentioned having an excellent high school teacher of chemistry, and one persistor and two non-persistors mentioned having an inspiring college chemistry teacher. As an illustration a student stated, "I enjoyed high school chemistry and was fortunate in having a teacher who showed enthusiasm for the subject and showed great interest in and encouragement to those in his classes who showed interest in chemistry. His course was quite well-organized, well-taught, of the proper degree of difficulty for high school students, and placed emphasis on the right things for an elementary course. This was probably the final deciding factor in my deciding to major in chemistry in college." Another student said, "If I may mention names, Dr.________ presents a very interesting course."

One persistor each listed aptitude tests, having a home chemistry set, having access to good scientific books as contributing to their selection of chemistry. For example, a student wrote, "High school aptitude tests showed that I had natural tendencies toward chemistry." Another said, "My own interest in chemistry began when I was eight or ten and got a small chemistry set for Christmas." Another wrote, "I would say that the book 'Chemistry for Boys' and the quality and novelty of the experiments in it probably is what influenced me most to select chemistry."

One persistor and one non-persistor each mentioned good job opportunities and parental encouragement as favoring their selection of chemistry. "I felt that chemistry would offer great opportunities," said one student. Another stated, "My parents allowed many raids on the trash cans behind the chemistry building at Oklahoma State University."

One non-persistor mentioned his elementary science instruction as contributing to selection. He said, "Somewhere in grade school . . . I was induced to a liking of sciences. . . . We listened to a weekly program called Science on the Air."

One non-selector each mentioned the following as contributing to non-selection: ability in another field shown by college aptitude tests, dislike of laboratory work, too large classes, mediocre chemistry teacher, dull course. Replies substantiating these views follow: "With the help of aptitude tests I decided on a business career." "I did not major in chemistry because I didn't enjoy working in a lab." "Oklahoma State University chemistry department could do a better job with smaller classes and better teachers." "Perhaps the chief reason for my not selecting chemistry as a major was that it was extremely dull."

Three non-selectors took chemistry to satisfy a general physical science requirement. One of them said, "I took chemistry because it satisfied a physical science requirement."

Responses Concerning Persistence

Two persistors each mentioned that knowledge of good-paying jobs in chemistry and well-trained college instructors contributed to their persistence in chemistry. For example, one graduate said, "I persisted because I felt the opportunities were good either in industry or teaching for chemistry majors. . . . Most of the professors made it interesting." One persistor each mentioned: encouragement from adviser, job in agricultural chemistry laboratory, less dislike of chemistry than anything else, feeling of accomplishment as contributing to their persistence. Replies supporting these factors were: "I persisted due to the encouragement of my college advisor." "I got a job in the Ag. Chem.

Lab. and this helped to hold my interest." "I persisted in chemistry because I enjoyed the subject." "My persisting in chemistry can best be explained by the feeling one gets after completing an experiment, a feeling of really accomplishing something." Eight non-persistors said they went into medicine and other fields which they considered better than chemistry from a financial standpoint. For example, one stated, "I changed to chemical engineering because I heard from many sources that the financial rewards and employment opportunities were greater."

Two blamed their poor mathematical background for non-persistence. "I was especially lacking in mathematics," said one.

One had to stay on the farm to care for his father and changed to agronomy. He said, "I began a major in chemistry, but my father who is seventy-five years old requested help to manage farm business affairs, so I changed to agronomy and returned to my father's farm."

One non-persistor said, "I became convinced that a chemist should possess an introvertic personality. I did not have this type personality so changed to industrial engineering." Another said, "I felt that my studies in chemistry were taking too much time, in detriment to my social life." "I did not persist in chemistry because I almost flunked physics," said one graduate. Another wrote, "I changed to chemical engineering so that I would not be working in a lab for the rest of my life." "I did not continue because I did not have the scientific background," said another.

Results From the Interview Records for Students Currently Enrolled

A frequency count was made of students mentioning certain factors as influencing selection of and persistence in chemistry. The factors were categorized in two fashions:

(1) According to the categories used in the 127-item rating scale.

(2) In accordance with the number of students among selectors and persistors, selectors and non-persistors, and non-selectors who mentioned certain factors. Interview comments recorded under these categories are given in Appendix K.

Experiences Influencing Selection of Chemistry as an Area of Specialization by College Undergraduates

Elementary grade experiences, as far as the 165 students who were interviewed were concerned, had little or no influence on their selection of chemistry as a major. Out of sixty-seven currently-enrolled students who selected chemistry as an area of specialization and persisted, only one said that elementary school experiences influenced his choice of chemistry as a major. He stated, "I feel that my interest in science developed as I went along in the grades. I had excellent elementary science teachers." Among the twenty-four non-persistors not one indicated that elementary school experiences had any unusual influence on his selection of chemistry as an area of specialization. Likewise, not one of the seventy-four non-selectors indicated that elementary school experiences had any influence on selection of chemistry in college.

On the other hand, secondary school experiences seemed to have greater influence upon selection of chemistry as a major. Eighteen of the sixty-seven selectors indicated that factors connected with their secondary school experiences were largely responsible for their selection of chemistry as an area of specialization. One of these eighteen said, "I found my high school chemistry course exciting. . . . I liked my teacher. He suggested I go to Oklahoma State University and major in chemistry." Half of the twenty-four non-persistors also said they selected chemistry primarily because of secondary school experiences. It may be noted here that twenty-seven per cent of those who selected chemistry and persisted indicated that factors connected with their secondary school experiences were largely responsible for their selection of chemistry as a major, whereas fifty percent of those who selected chemistry but did not persist stated factors in the same category most influenced their selection of chemistry. One-third of the ninety-one selectors cited secondary school experiences as major factors in their choice of chemistry as an area of specialization. Among the seventy-four non-selectors, the ones who had had high school chemistry generally liked it. For example, one said, "I had a good high school course in chemistry and thought I'd like more of it, so I took it in college." However, another non-selector said, "My high school teacher told me chemistry was a hard field - 90% flunk out - I was scared to major in it after what my high school teacher said."

College experiences, as far as the 165 interviewees were concerned, had the greatest influence on their selection of chemistry as a major. Half of the sixty-seven (thirty-three) persistors said they selected chemistry primarily because of college experiences. One stated, "I took chemistry as a science requirement in the College of Commerce. I had two very capable and inspiring college chemistry teachers. They sold me on chemistry, and I changed to a chemistry major because of them." Only four of the twenty-four non-persistors said they selected chemistry as a major primarily because of college experiences. As far as the ninety-one selectors were concerned, a higher percentage (41%) selected chemistry because of college experiences than for any other major reason. One may infer that as far as this group of ninety-one is concerned, if chemistry is selected by students as a result of college experiences, the students are more likely to persist in it. Fifty-five out of seventy-four students who took chemistry without selecting it as a major had in mind one or more fields in which to major which would require chemistry. For example, one student said, "I was undecided my first semester whether to major in commercial art, mechanical engineering or geology. I needed chemistry for two of them so I took it, giving "general" for my major." Eighteen out of seventy-four non-selectors took chemistry to satisfy a physical science requirement in the College of Arts and Sciences. To illustrate, one stated, "I took chemistry here for a physical science requirement. My Arts and Sciences' adviser didn't mention any physical science other than chemistry for me to take." In not more than two or three cases were students browsing around to see in what they might like to major. One of the students said, "I thought I wanted some science field for a major - so took chemistry - it would fit into any major chosen later." One of the seventy-four took chemistry to fulfil a desire for a liberal education. A check on the professors that the non-selectors had, showed that they had twice as many "poor" freshman chemistry teachers as "good" ones. "Poor" and "good" were assigned professors according to opinions expressed by both selectors and non-selectors. Had the non-selectors been attracted to chemistry, as was done in several instances for students who had declared they were majoring in something else but changed to chemistry after taking a course with Dr. ______, several of them might have decided to major in it. A study of responses of non-selectors reveal some of the unattractiveness of chemistry as taught at Oklahoma State University. Fifty-four of the seventy-four non-selectors had experiences in college chemistry which apparently made the field unattractive to them. For example, a student said, "I thought I'd like chemistry here, but Dr. ______ scared me so badly I've never got up enough nerve to take any more. . . . If I have to take any more chemistry, I'll go somewhere else to take it. . . . I made a C, but I don't know and never knew any chemistry. . . . Professor ______ used four-syllable words. . . . Also, I couldn't stand ______ screaming across the laboratory at me calling me an ignoramus. . . . I've got feelings." Other ungarnished statements given by uninhibited students are recorded in Appendix K in the hope that some forward steps may be taken to improve the situation.

Home experiences seemed to influence a few students in their selection of chemistry as a major. Ten of the selectors and persistors cited home experiences as influencing them the most to select chemistry as a major. One student said, "When I was eight or ten years old, I got my first chemistry set. At the age of twelve or thirteen my dad bought me a deluxe set. I gathered other equipment and had a lab in the basement at home. . . . I took chemistry in high school under an inspiring and well-trained teacher, but I had already made up my mind to major in chemistry." Five of the non-persistors said that home experiences influenced them the most to select chemistry as a major. The non-selectors cited very few home experiences that could influence their selection of chemistry. One student who had enjoyed working with home chemistry sets lost his enthusiasm while taking his first college course in chemistry.

Under the category of factors connected with students' experiences with the public and government, five persistors and three non-persistors were chiefly influenced by acquaintances to select chemistry as a major. To illustrate, one stated, "While I was a pharmacist's mate in the service I worked around drugs. . . . A friend there was a chemist, and he used to talk about chemistry being a good field, so I decided to major in it when I got back from military duty."

None of the interview reports seemed to indicate that factors of a personal nature predominantly influenced selectors to choose chemistry. Hence, none were listed under that category. However, nineteen of seventy-four non-selectors indicated factors of a personal nature influenced their non-selection of chemistry. These factors were chiefly associated with students' interests in fields other than chemistry. For example, one stated, "I took chemistry at a time when I was looking forward to going into engineering."

Table XX is a frequency count of students which contrasts persistors, non-persistors, and non-selectors according to the influence of broad categories associated with selection of chemistry.

Specific factors under the broad categories were examined, a frequency count made, and percentages of persistors and non-persistors stating that certain factors were associated with their choice of chemistry as a major were calculated and recorded in Appendix L. Table XXI shows the top ten of these factors, in order of decreasing percentage for persistors.

Persistors and non-persistors agreed that the three specific factors most frequently associated with their selection of chemistry as an area of specialization were:

1. Use of chemistry sets as gifts when children.

2. Quality of the background in chemistry obtained by high school students.

TABLE XX

FREQUENCY COUNT OF OKLAHOMA STATE UNIVERSITY INTERVIEWEES, PERSISTORS, NON-PERSISTORS, AND NON-SELECTORS, ACCORDING TO THE INFLUENCE OF BROAD CATEGORIES OF FACTORS ASSOCIATED WITH SELECTION OF CHEMISTRY

Categories of Factors	Persistors	Non-Persistors	Total Selectors	Non-Selectors
1. Elementary school experiences	1	0	1	0
2. Secondary school experiences	18	12	30	1
3. College experiences	33	4	37	54
4. Home experiences	10	5	15	0
5. Experiences with the public and government	5	3	8	0
6. Personal factors	0	0	0	19
Total number	67	24	91	74

TABLE XXI

TOP TEN FACTORS ASSOCIATED WITH SELECTION OF CHEMISTRY AS A MAJOR BY NINETY-ONE OKLAHOMA STATE UNIVERSITY INTERVIEWEES (SIXTY-SEVEN PERSISTORS AND TWENTY-FOUR NON-PERSISTORS) RANKED IN DESCENDING ORDER ACCORDING TO PERCENTAGE OF PERSISTORS

Item No.	Item	Percentage of Persistors	Percentage of Non-Persistors
1.	Use of chemistry sets as gifts when children	45%	33%
2.	Quality of the background in chemistry obtained by high school students	39%	54%
3.	Academic qualifications of high school chemistry teachers	33%	54%
4.	Abilities of freshman chemistry teachers to inspire students	25%	4%
5.	Parental advisement and encouragement to major in chemistry	21%	8%
6.	Encouragement from peers to select chemistry as an area of specialization	16%	17%
7.	Friendly and helpful attitudes on the part of college chemistry teachers toward their freshman students	13%	4%
8.	Abilities of professors to gear instruction in the theory of general chemistry to the level of beginning students	9%	0%
9.	Adequacy of science taught in the elementary grades	9%	0%
10.	Adequacy of advisement of college students with regard to chemistry as their major	7%	4%

3. Academic qualifications of high school chemistry teachers.

Persistors and non-persistors disagreed about the influence college chemistry teachers had on their selection of chemistry. Persistors expressed the opinion that the following three specific factors were associated with their selection of chemistry to a greater degree than was the case with non-persistors:

1. Abilities of freshman chemistry teachers to inspire students.

2. Friendly and helpful attitudes on the part of college chemistry teachers toward their freshman students.

3. Abilities of professors to gear instruction in the theory of general chemistry to the level of beginning students.

Perhaps this difference of opinion between persistors and non-persistors may be attributed to the fact that the non-persistors more frequently had chemistry teachers who taught general chemistry poorly.

Parents of persistors had a greater influence on their children's selection of chemistry as a major than parents of non-persistors, whereas peers almost equally influenced persistors and non-persistors to select chemistry as an area of specialization.

Persistors mentioned the following two items more frequently than did non-persistors as factors influencing their selection of chemistry:

1. Adequacy of science taught in the elementary grades.

2. Adequacy of advisement of college students with regard to chemistry as their major.

In addition to the top ten factors listed in Table XXI attention is directed to items 25 and 30 in Appendix L, which were factors associated with selection of chemistry by a number of non-persistors. While looking over these twelve factors, one should not infer, for example, that "use of chemistry sets as gifts when children" is the most important factor influencing the selection of chemistry as a major. It was only the most frequently mentioned by persistors as favoring selection. For a particular student who had had a chemistry set at home there might have been a more important factor influencing his choice of chemistry as an area of specialization. For example, one student said, "I had a chemistry set as a boy. . . . I took high school chemistry. . . . My dad suggested chemistry as a good field, but I talked with college advisers before finally making up my mind to enroll in chemistry."

One may infer from the frequency study of the interview reports that college experiences influence selection of chemistry as a major more than anything else. Secondary school experiences follow as next most frequently mentioned, and in turn, home experiences, experiences with the public and government, elementary school experiences, and personal factors.

Experiences Influencing Persistence in Chemistry as an Area of Specialization by College Undergraduates

College classroom and laboratory experiences, as far as the ninety-one selectors who were interviewed were concerned, had the most influence on their persistence in chemistry as an area of specialization. Forty-seven of the sixty-seven students who selected chemistry as a major and persisted indicated that factors connected with their experiences in the classroom and laboratory were largely responsible for their persistence in chemistry as a major. A number of the persistors had some of the same unpleasant experiences as non-persistors, yet in most instances there was something else to counter-balance the unpleasant and cause them to continue with chemistry. However, in a few cases students indicated they were going to make a change in their major the next time they enrolled. For example, one said, "I enjoyed chemistry 114 - had Dr. ______. Now

I have ______, and I can't make heads or tails out of my notes. Also I have a lab instructor who can't answer many questions put to him - he's not much help. I'm going to change majors." Twenty of the twenty-four non-persistors indicated factors connected with their experiences in college classroom and laboratory were largely responsible for their non-persistence in chemistry. To illustrate, one student stated, "I worked in the chemistry storeroom, and the stress and strain in dealing with chemistry professors was the main factor which caused me to change. If the experiment went wrong, we got eaten out - also, profs would want something right away. I know two others who got disgusted with chemistry and changed because of storeroom experiences. My lack of spelling ability was also a handicap in organic chemistry where single letters often made a big difference in answers." Seventy-four per cent of the selectors cited experiences in the college classroom and laboratory as largely influencing their persistence in chemistry.

On the other hand, personal factors seemed to have little influence on persistence in chemistry. Only six of the sixty-seven persistors mentioned personal factors as being largely responsible for their persistence in chemistry. For example, one said, "I thought about being a veterinarian, but since I'm married and have one child, I decided I could complete chemistry in four years and be ready to make a good living for my family. I wasn't sure I'd be able to finance vet. school." Only one non-persistor stated that personal factors were the main reasons for her discontinuing chemistry. She said, "At the end of my junior year, with four hours of C at Colorado University and nine hours A and nine hours B at Oklahoma State, I talked with three representatives of commercial companies. They said there were just no opportunities for women chemists other than chemical library work. I was absolutely not interested in that, so I switched to education and the teaching of science and math. They talk about opportunities for women chemists, but when it comes right down to hiring women chemists employers don't do it."

There were several miscellaneous factors which influenced persistence in chemistry. Fourteen of the sixty-seven who persisted gave responses which were placed in the miscellaneous category. To illustrate, one said, "An uncle of mine has kept my interest up - good job easy to find, et cetera. When I tell girl friends I'm majoring in chemistry they look at me like they thought I was crazy." Three of the non-persistors gave reasons for quitting chemistry which were of miscellaneous nature. One stated, "I didn't finish my degree - got married - ten years later I decided to finish as soon as possible. Found out I could finish in education and teach science, so changed majors."

Table XXII is a frequency count of students which contrasts persistors and non-persistors according to the influence of broad categories associated with persistence in chemistry.

Specific factors under the broad categories were examined, a frequency count made, and percentages of persistors and non-persistors stating that certain factors were associated with their persistence in chemsitry as a major were calculated and recorded in Appendix L. Table XXIII shows the top eight of these factors, in order of decreasing percentage for persistors.

In table XXIII marked differences between persistors and non-persistors may be seen. As far as the sixty-seven persistors were concerned, persistence in chemistry was more frequently associated with the kind of chemistry professors they had than with anything else. The students persisted because they had chemistry professors who were friendly and

TABLE XXII

FREQUENCY COUNT OF OKLAHOMA STATE UNIVERSITY INTERVIEWEES, PERSISTORS AND NON-PERSISTORS, ACCORDING TO THE INFLUENCE OF BROAD CATEGORIES OF FACTORS ASSOCIATED WITH PERSISTENCE IN CHEMISTRY

Categories of Factors	Persistors	Non-Persistors
College experiences in the classroom and laboratory	47	20
Personal factors	6	1
Miscellaneous factors	14	3
Total number	67	24

who not only knew the subject-matter of chemistry but knew how to teach it. In addition their professors inspired them and offered them adequate advisement. On the other hand, the twenty-four non-persistors had professors who were not so helpful, friendly, and inspirational, who were not so well-trained in subject-matter and methods of teaching, and who did not advise the students adequately. In addition, the advisement and encouragement of parents helped to keep some of the persistors majoring in chemistry, whereas this factor had no positive influence on persistence as far as the non-persistors were concerned. Apparently, economic status of students affected persistors and non-persistors to the same degree of frequency, approximately. In addition to the top eight factors listed in Table XXIII, attention is directed to items 11 and 15 in Appendix L, which were factors associated with persistence in chemistry by a number of non-persistors.

The frequency study of the interview reports seemed to show that

TABLE XXIII

TOP EIGHT FACTORS ASSOCIATED WITH PERSISTENCE IN CHEMISTRY AS A MAJOR BY NINETY-ONE OKLAHOMA STATE UNIVERSITY INTERVIEWEES (SIXTY-SEVEN PERSISTORS AND TWENTY-FOUR NON-PERSISTORS) RANKED IN DESCENDING ORDER ACCORDING TO PERCENTAGE OF PERSISTORS

Item No.	Item	Percentage of Persistors	Percentage of Non-Persistors
1.	Friendly and helpful attitudes on the part of chemistry professors toward their students	66%	4%
2.	Training of chemistry professors in teaching	49%	0%
3.	Training of chemistry professors in chemistry	48%	0%
4.	Abilities of chemistry professors to inspire students	48%	4%
5.	Parental advisement and encouragement to continue with a major in chemistry	24%	0%
6.	Adequacy of advisement for chemistry students after selection of chemistry as their major	20%	4%
7.	Economic status of students	7%	4%
8.	General intelligence of students	7%	0%

the experiences of the students in the college classroom and laboratory exerted a more potent influence upon their persistence in majoring in chemistry than other factors included in other categories.

Certain Results From Office and Interview Records for Students Currently Enrolled

Comparisons were made among interviewees for certain miscellaneous factors. Information for this comparison was obtained partly from the interview records and partly from records in offices of Oklahoma State University.

Comparisons Between Persistors and Non-Persistors

Certain miscellaneous factors were compared between persistors and non-persistors. Results are given in Table XXIV.

Using information presented in Table XXIV one may infer, as far as the selectors of chemistry are concerned, that if a student overloads himself with extra-curricular activities he will tend not to persist in chemistry. The same thing can be said for social activities. There are no outstanding differences between persistors and non-persistors regarding frequency of out-of-town trips, chemistry grades, and year for deciding to major in chemistry.

Comparisons Among Persistors, Non-Persistors, and Non-Selectors

Comparisons were made among persistors, non-persistors, and non-selectors of certain courses had in high school which appeared to be associated with selection of and persistence in chemistry. Also, the percentages of the three groups who had home chemistry sets were compared. These comparisons are shown in Table XXV.

TABLE XXIV

PERCENTAGES OF SIXTY-SEVEN PERSISTORS AND TWENTY-FOUR NON-PERSISTORS FOUND FOR CERTAIN MISCELLANEOUS FACTORS

Item No.	Item	Percentage of Persistors	Percentage of Non-Persistors
1.	Having zero to two extra-curricular activities	72%	0%
2.	Having three or four extra-curricular activities	20%	71%
3.	Having excess of four extra-curricular activities	8%	29%
4.	Having zero to few social activities	67%	0%
5.	Having average number of social activities	18%	71%
6.	Having excessive social activities	15%	29%
7.	Going out-of-town infrequently (none or vacations only)	56%	50%
8.	Going out-of-town every three to seven weeks	23%	34%
9.	Going out-of-town every week or two	21%	16%
10.	Per cent "A" grades in chemistry courses	36%	21%
11.	Per cent "B" grades in chemistry courses	38%	24%
12.	Per cent "C" grades in chemistry courses	22%	31%
13.	Per cent "D" grades in chemistry courses	2%	17%
14.	Per cent "F" grades in chemistry courses	2%	7%

Table XXIV (continued)

Item No.	Item	Percentage of Persistors	Percentage of Non-Persistors
15.	Per cent deciding to major in chemistry the freshman year	61%	75%
16.	Per cent deciding to major in chemistry the sophomore year	24%	25%
17.	Per cent deciding to major in chemistry the junior year	11%	0%
18.	Per cent deciding to major in chemistry the senior year	4%	0%

TABLE XXV

COMPARISONS AMONG SIXTY-SEVEN PERSISTORS, TWENTY-FOUR NON-PERSISTORS AND SEVENTY-FOUR NON-SELECTORS AS TO CERTAIN MISCELLANEOUS ITEMS

Item	Percentage of Persistors	Percentage of Non-Persistors	Percentage of Non-Selectors
Had general science	95%	92%	43%
Had biology	72%	67%	34%
Had physics	52%	42%	12%
Had chemistry	76%	67%	27%
Had algebra	99%	100%	54%
Had geometry	88%	83%	45%
Had trigonometry	33%	25%	16%
Had home chemistry set	45%	33%	2%

Perusal of the table shows that a higher percentage of selectors, as compared with non-selectors, had had high school general science, biology, physics, chemistry, algebra, geometry, and trigonometry as well as home chemistry sets. One might infer that as far as the interviewees are concerned, having these experiences tends to favor selection of chemistry. However, there are not very large differences between persistor and non-persistor percentages. All percentages for persistors are greater than for non-persistors except for algebra (only one per cent difference). These facts might lead one to infer that there must be other factors which influence persistence in chemistry. The percentages for trigonometry and physics are smaller for a given student group than the percentages for other high school courses. One may infer that trigonometry and physics are of less importance as regards selection of and persistence in chemistry than the other courses in the table.

The ages of persistors, non-persistors, and non-selectors were compared. Table XXVI shows the frequency distributions of various age groups for persistors, non-persistors, and non-selectors. Also, the mean and standard deviation for each group of interviewees is shown.

From Table XXVI, the mean ages for persistors, non-persistors, and non-selectors were 22.5, 24.0, and 21.9, respectively. The age ranges for the three groups were nineteen to thirty-six, twenty to thirty, and nineteen to twenty-eight. However, there were only three persistors with ages over twenty-eight. The evidence is inconclusive that age has influence upon selection of and persistence in chemistry.

Comparison of the Undergraduate Interviewees with Reference to A.C.E. Scores

The American Council on Education Psychological Examination for

TABLE XXVI

COMPARISON OF THE AGES OF SIXTY-SEVEN PERSISTORS, TWENTY-FOUR NON-PERSISTORS, AND SEVENTY-FOUR NON-SELECTORS

Age Groups	Frequency Persistors	Non-Persistors	Non-Selectors
34-36	1	0	0
31-33	2	0	0
28-30	1	3	1
25-27	8	7	10
22-24	24	9	25
19-21	31	5	38
N	67	24	74
Mean	22.5	24.0	21.9
Standard Deviation	3.18	2.82	2.28

College Freshman (A.C.E.) scores for persistors, non-persistors, and non-selectors were compared. The A.C.E. scores of only thirteen of the twenty-four non-persistors were available. Sixty-six of the sixty-seven persistors and fifty-six of the seventy-four non-selectors had A.C.E. scores on record. Table XXVII shows the distribution of A.C.E. scores, the mean A.C.E. score and the standard deviation for each group. The mean A.C.E. score for persistors was 66.9, that for non-persistors was 47.4, and that for non-selectors 37.5. One may see from this comparison that the interviewees who selected chemistry and persisted had higher A.C.E. scores on the average than undergraduates who selected chemistry but did not persist, and that non-persistors had higher A.C.E. scores on the average than non-selectors.

TABLE XXVII

COMPARISON OF THE A.C.E. SCORES AMONG SIXTY-SIX PERSISTORS, THIRTEEN NON-PERSISTORS, AND FIFTY-SIX NON-SELECTORS

A.C.E. Score Intervals	Persistors' Frequency	Non-Persistors' Frequency	Non-Selectors' Frequency
95-99	14	0	0
90-94	7	0	1
85-89	6	1	1
80-84	4	0	1
75-79	2	2	2
70-74	2	1	2
65-69	3	1	2
60-64	3	0	4
55-59	3	2	1
50-54	6	0	4
45-49	0	0	2
40-44	1	0	4
35-39	5	0	3
30-34	3	2	3
25-29	0	0	4
20-24	0	0	5
15-19	1	2	5
10-14	2	2	9
5-9	3	0	2
0-4	1	0	1
N	66	13	56
Mean	66.9	47.4	37.5
Standard Deviation	28.75	26.80	21.65

Would factors associated with selection of and persistence in chemistry be different among persistors, non-persistors, and non-selectors if the students in the groups were matched according to A.C.E. scores? In order to answer this question three groups of thirteen students each were selected. The thirteen non-persistors who had A.C.E. scores on record were matched with persistors and non-selectors who had the same or approximately the same A.C.E. score. The mean A.C.E. scores for the three groups were the same. Table XXVIII shows individual A.C.E. scores for students in the three groups, mean score, standard deviation, standard error of the mean, 2.18 σ value, and true mean limits for each group.

The number of degrees of freedom for each group of thirteen students is twelve. Hence from a t-table, 2.18 times each standard error of the mean gives the plus-minus value to be added to the mean of forty-seven to show the limits within which the true mean lies for ninety-five per cent of the entire population. The limit, (30-64), for the true mean of 95% of the population varies a great deal from the actual mean of 47 for each group. Hence, the results of this detailed study of thirty-nine students are not significant if applied to the entire population of perhaps thousands of cases. But this study was limited to students at Oklahoma State University and covered only years 1952-53 to 1955-56, inclusive. The thirteen students in each group are twenty per cent of the persistors, fifty-four per cent of the non-persistors, and eighteen per cent of the non-selectors considered in this study. Hence, results found for the three groups of thirteen students each should be more significant as applied to the population for this study.

Data from office and interview records were used to show the following differences among the three groups of students selected on the basis of A.C.E. scores:

TABLE XXVIII

COMPARISON OF THE A.C.E. SCORES AMONG GROUPS OF THIRTEEN PERSISTORS, THIRTEEN NON-PERSISTORS, AND THIRTEEN NON-SELECTORS THAT HAD THE SAME MEAN A.C.E. SCORE

	A.C.E. Score		
	Persistors	Non-Persistors	Non-Selectors
	11	10	11
	11	11	11
	9	16	16
	18	18	18
	34	33	32
	36	34	34
	56	58	61
	59	58	58
	67	67	67
	71	73	73
	76	75	75
	83	77	79
	84	85	82
Mean A.C.E. Score	47	47	47
Standard Deviation	27.6	26.7	26.6
Standard Error of the Mean	7.97	7.71	7.69
2.18 σ Value	17.4	16.8	16.8
True Mean Limits	30-64	30-64	30-64

		Persistors	Non-Persistors	Non-Selectors
1.	Number that had high school chemistry	10	8	5
2.	Number that had general science	9	12	4
3.	Number that had high school biology	10	8	3
4.	Number that had high school physics	7	6	1
5.	Number that had high school algebra	13	13	6
6.	Number that had high school geometry	12	10	6
7.	Number that had home chemistry set	5	9	1
8.	Number that elementary science influenced	2	1	0
9.	Number that high school counselors told to take chemistry as a major	2	2	0
10.	Declared major in chemistry freshman year	7	11	-
11.	Declared major in chemistry sophomore year	5	2	-
12.	Declared major in chemistry junior year	0	0	-
13.	Declared major in chemistry senior year	1	0	-
14.	Per cent "A" grades	27%	21%	7%
15.	Per cent "B" grades	45%	24%	20%
16.	Per cent "C" grades	20%	38%	60%
17.	Per cent "D" grades	4%	17%	13%
18.	Per cent "F" grades	4%	0%	0%
19.	Per cent "good" college chemistry teachers had	61%	50%	39%

		Persistors	Non-Persistors	Non-Selectors
20.	Per cent "poor" college chemistry teachers had	39%	50%	61%
21.	Number had foreign laboratory instructors	1	1	3
22.	Number selecting chemistry with vocation of chemist in mind at start	8	13	-
23.	Number selecting chemistry with different vocation (medicine, and so on) in mind at start	5	0	-
24.	Per cent from small towns	54%	70%	50%
25.	Per cent from large towns	39%	23%	30%
26.	Per cent from cities	7%	7%	20%
27.	Per cent that parents urged to major in chemistry	8%	8%	0%
28.	Per cent that had good science books and magazines in the home	31%	0%	0%

An examination of the above results shows, for the thirty-nine students involved, that taking science and mathematics in high school was more frequently associated with selecting chemistry in college rather than with not selecting it. A much larger proportion of selectors than non-selectors owned home chemistry sets; and the persistent selectors were outstanding in the extent to which they reported the presence of good science books and magazines at home. There appeared to be a discernible difference between the selectors and non-selectors in reporting good chemistry teachers. On the other hand, there was an equally discernible difference between the persistors on the one hand and the non-persistors and non-selectors on the other in reporting poor chemistry teachers.

If these matched samples are fairly representative, (1) experience with science and mathematics courses, owning chemistry sets, and exposure to science books and magazines in the high school years appears to be associated with the selection of chemistry as a major in college; (2) experience with good chemistry teachers is associated with selection of chemistry as a major, but experience with poor teachers is associated with non-selection of chemistry as a major and with not persisting with a major in chemistry even after it had been selected.

Comparison of Results Obtained From the Three Sources: Land Grant College Professors, Graduates, and Undergraduates

Land Grant College Professors and the Currently Enrolled Undergraduates

Since a rating scale was not checked by the interviewees, comparisons between them and the land grant college educators could not be made as precisely as the comparisons between graduates of Oklahoma State University and professors in land grant colleges. Collation of interview results and frequency counts for various factors mentioned were used as a basis for comparison with the returns from land grant college educators. Marked likenesses and differences were noted.

Most frequently mentioned by both interviewees and land grant college educators as favoring selection of chemistry were:

1. Abilities of freshman chemistry teachers to inspire students.
2. Friendly and helpful attitudes on the part of college chemistry

teachers toward their freshman students.

3. Abilities of professors to gear instruction in the theory of general chemistry to the level of beginning students.

4. Quality of the background in chemistry obtained by high school students.

5. Academic qualifications of high school chemistry teachers.

6. Adequacy of science taught in the elementary grades.

7. Adequacy of advisement of college students with regard to chemistry as their major.

8. Students' having had chemistry in high school.

9. Scientific interests of students.

10. Scientific aptitudes of students.

11. Adequacy of science taught in the secondary schools.

12. Training of college chemistry teachers.

13. Adequacy of mathematics taught in the secondary schools.

14. General intelligence of students.

15. Attitudes of high school counselors toward the pursuit of chemistry.

The interviewees and land grant college educators differed with reference to (1) parental advisement and encouragement to major in chemistry and (2) encouragement from peers to select chemistry as an area of specialization as factors influencing selection. The consensus of land grant college educators was that these two factors only occasionally favor selection of chemistry. Furthermore, professors of land grant colleges ranked "use of chemistry sets as gifts when children" as sixty-two in a list of seventy-nine factors favoring selection, whereas interview data showed that forty-five per cent of the persistors, thirty-three per cent of the non-persistors, and only two per cent of the non-selectors had had home chemistry sets.

Most frequently mentioned by both interviewees and land grant college educators as favoring persistence in chemistry were:

1. Friendly and helpful attitudes on the part of chemistry professors toward their students.

2. Training of chemistry professors in chemistry.

3. Abilities of chemistry professors to inspire students.

4. Adequacy of advisement for chemistry students after selection of chemistry as their major.

5. Parental advisement and encouragement to continue with a major in chemistry.

6. Scientific aptitudes of students.

7. Abilities of professors to gear instruction in the theory of general chemistry to the level of the beginning student.

8. General intelligence of students.

There were a few marked differences of opinion between interviewees and land grant college professors. Second most frequently-mentioned factor by interviewees as favoring persistence in chemistry was "training of chemistry professors in teaching." Land grant college educators ranked this factor 20½ in a list of forty-eight. Only two per cent of the persistors and none of the non-persistors said that "the degree to which brilliant chemistry students are challenged to do the best of which they are capable" favors persistence, whereas land grant college educators ranked this factor seventh in a list of forty-eight.

The Graduates and the Currently
Enrolled Undergraduates

Graduates and currently enrolled students were in agreement that the following factors usually favor selection of chemistry as an area of specialization:

1. Friendly and helpful attitudes on the part of college chemistry teachers toward their freshman students.

2. Quality of the background in chemistry obtained by high school students.

3. Academic qualifications of high school chemistry teachers.

4. Abilities of freshman chemistry teachers to inspire students.

5. Abilities of professors to gear instruction in the theory of general chemistry to the level of beginning students.

6. Scientific interests of students.

7. Scientific aptitudes of students.

8. Training of college chemistry teachers.

9. Students' having had chemistry in high school.

10. Attitudes of high school counselors toward the pursuit of chemistry.

Graduates also mentioned the following as usually favoring selection of chemistry as a major:

1. Training of physics, biology, and general science teachers in the secondary schools.

2. Efforts made to detect and encourage college-bound students with science talent to select chemistry in college.

3. Adequacy of science taught in the secondary schools.

4. Adequacy of mathematics taught in the secondary schools.

Currently-enrolled students did not mention items (1) and (2) above and mentioned (3) and (4) rather infrequently.

Most frequently mentioned by graduates and currently-enrolled students as favoring persistence in chemistry were:

1. Friendly and helpful attitudes on the part of chemistry professors toward their students.

2. Training of chemistry professors in chemistry.

3. Abilities of chemistry professors to inspire students.

4. Adequacy of advisement for chemistry students after selection of chemistry as their major.

5. Scientific aptitudes of students.

6. General intelligence of students.

7. Training of chemistry professors in teaching.

Currently-enrolled students mentioned "parental advisement and encouragement to continue with a major in chemistry" rather frequently, whereas graduates did not. On the other hand graduates frequently mentioned "the degree to which brilliant chemistry students are challenged to do the best of which they are capable," whereas currently-enrolled students did not.

Summary of Results

In light of all these facts and findings, what are the factors which favored the selection of and persistence in chemistry as an area of specialization by undergraduates at Oklahoma State University during the years included in the study? The evidence supplied by the data from land grant college educators, interviewees, and graduates suggested that the following factors (listed in approximate rank order) were always or usually associated with the selection of chemistry as a major:

1. Scientific interests of students.

2. Scientific aptitudes of students.

3. Friendly and helpful attitudes on the part of college chemistry teachers toward their freshman students.

4. Abilities of freshman chemistry teachers to inspire students.

5. Quality of the background in chemistry obtained by high school students.

6. Training of college chemistry teachers.

7. Academic qualifications of high school chemistry teachers.

8. Abilities of professors to gear instruction in the theory of general chemistry to the level of beginning students.

9. Students' having had chemistry in high school.

10. Attitudes of high school counselors toward the pursuit of chemistry.

11. Adequacy of science taught in the secondary schools.

12. Training of physics, biology, and general science teachers in the secondary schools.

13. Efforts made to detect and encourage college-bound students with science talent to select chemistry in college.

14. Parental advisement and encouragement to major in chemistry.

15. Use of chemistry sets as gifts when children.

16. Encouragement from peers to select chemistry as an area of specialization.

17. Students' having had physics in high school.

The evidence supplied by the data suggested that the following factors (listed in approximate rank order) were occasionally associated with the selection of chemistry as a major by undergraduates at Oklahoma State University during the years included in the study:

1. Adequacy of mathematics taught in the secondary schools.

2. Abilities of chemistry laboratory instructors to speak and understand English.

3. Adequacy of advisement of college students with regard to chemistry as their major.

4. Presence of good books and magazines on science at home.

5. Students' having had algebra in high school.

6. Adequacy of science taught in the elementary grades.

7. Adequacy of mathematics taught in the elementary grades.

8. Efforts made from the fifth through the eighth grade to detect and encourage students with science talent to select science and mathematics courses in high school.

9. Adequacy of equipment to teach science in elementary schools.

10. Adequacy of English courses taught in high school.

11. Advisement and encouragement of promising young people by chemists and organizations of chemists to enter chemistry as a career.

12. Extent of participation in social activities by students while attending college.

13. Extent to which students participate in extra-curricular activities.

14. Non-acceptance at medical and dental colleges or inability to finance schooling at such colleges.

15. Students' having had geometry in high school.

16. Students' having had trigonometry in high school.

17. Students' having had general science in high school.

18. Students' having had biology in high school.

19. Amount of emphasis in general chemistry on the cultural aspects of chemistry.

20. Moderate size of classes in elementary schools.

The evidence supplied by the data suggested that the following factors (listed in approximate rank order) were always or usually associated with persistence in chemistry as an area of specialization by undergraduates at Oklahoma State University during the years included in the study:

1. Friendly and helpful attitudes on the part of chemistry professors toward their students.

2. Scientific aptitudes of students.

3. Training of chemistry professors in teaching.

4. Abilities of chemistry professors to inspire students.

5. Training of chemistry professors in chemistry.

6. General intelligence of students.

7. Adequacy of advisement for chemistry students after selection of chemistry as their major.

8. Abilities of professors to gear instruction in the theory of general chemistry to the level of the beginning student.

9. Parental advisement and encouragement to continue with a major in chemistry.

10. Students' mathematical abilities.

11. The degree to which brilliant chemistry students are challenged to do the best of which they are capable.

12. Choice of major in chemistry in the junior year.

The evidence supplied by the data suggested that the following factors (listed in approximate rank order) were occasionally associated with persistence in chemistry as an area of specialization by undergraduates at Oklahoma State University during the years included in the study:

1. Abilities of chemistry lecturers to use readily understood English.

2. Abilities of chemistry laboratory instructors to speak and understand English.

3. Adequacy of equipment in college chemistry laboratories.

4. Condition of buildings housing chemistry laboratories.

5. Moderate size of laboratory classes in chemistry, especially during the freshman year.

6. Grades received in chemistry courses.

7. Amount of outside preparation involved in the pursuit of chemistry as a major.

8. Students' knowledge of good-paying jobs in the field of chemistry.

9. Encouragement from peers to persist in chemistry.

10. Necessity of spending three hours in chemistry laboratory work per week for one semester-hour credit.

11. Emphasis on the disciplinary aspects in courses in general chemistry.

12. Emphasis on the cultural aspects in courses in general chemistry.

13. Abilities of students to express their thoughts both orally and in writing.

14. Attitudes of chemistry storeroom employees toward students.

15. Military service experiences between the start and completion of a bachelor's degree.

16. Time spent in social activities by students while attending college.

17. Time put in by students on extra-curricular activities.

18. Sex of students.

19. Non-acceptance at medical and dental colleges or inability to finance schooling at such colleges.

20. Attitudes of professors toward storeroom employees majoring in chemistry.

21. Conflict between chemistry course schedules and jobs essential to students'staying in college.

22. Economic status of students.

23. Type of summer employment in chemical industry.

CHAPTER VI

CONCLUSIONS AND RECOMMENDATIONS

From the beginning this study has been concerned with the problem of identifying factors which are associated with the selection of chemistry as an area of specialization by undergraduates at Oklahoma State University, and with persistence in chemistry on their part. It was proposed, as an hypothesis, that these factors could be identified. A procedure for testing the hypothesis was designed. The procedure included the use of a rating scale, with opportunity for additional comments, sent to land grant college educators; a revised scale, with opportunity for free responses, sent to graduates of Oklahoma State University; and free-response interviews with currently-enrolled undergraduates of Oklahoma State University. Comparisons were made among and within the groups to obtain a consensus of those people - students, instructors and others - who were intimately associated with undergraduate instruction in chemistry. Certain factors which favor selection of and persistence in chemistry as a major by Oklahoma State University undergraduates have been identified by the use of this procedure.

Conclusions

1. It appears that certain environmental and social and educational factors are present in selection of chemistry as a major by undergraduates.

2. Also, certain environmental and social and educational factors appear to be present in the process of persistence in chemistry.

3. There are some factors associated exclusively with persistence in chemistry and are therefore not particularly associated with selection of chemistry.

4. The method used for this study is applicable to similar studies elsewhere, not only in chemistry, but also in such fields as physics and mathematics.

Recommendations

In order to learn whether the factors associated with selection of and persistence in chemistry as a major by Oklahoma State University undergraduates would be the same at other institutions of higher learning, it is recommended that similar studies in chemistry be made at other colleges and universities.

Furthermore, it is recommended that similar studies in the fields of physics and mathematics be made at Oklahoma State University. Physics and mathematics seem to be two other areas in which a shortage of majors exists.

Weaknesses of the Study

One weakness of the study was that in some areas the population was not as large as needed for making well-founded inferences.

Another weakness was the lack of precise comparisons among land grant college educators, undergraduates, and graduates which should have been possible had it been practical and desirable for all individuals in the three groups to check the same rating scale.

Further Recommendations

The recommendations given here are offered with the hope that they might contribute to an increase in the number of students selecting and persisting in chemistry at Oklahoma State University.

Recommendations about Selection

Since factors connected with the elementary school experiences have been found to be associated only occasionally with selection of chemistry by Oklahoma State University undergraduates, nothing urgent is recommended to improve the situation at the elementary school level. However, more emphasis should be placed on quality than quantity of instruction in mathematics and science. Classes should be of moderate size and equipment adequate. Greater efforts should be made, beginning about the fifth grade, to detect students with science talent and to encourage them to select science and mathematics courses in high school.

At the secondary school level, it is urgently recommended that more students with the ability to learn science be encouraged to study general science, biology, physics, and chemistry under inspiring teachers who are well-trained in the subject matter of science and in how to teach, and whose departments are well-equipped for teaching science. The high school students who show an interest in chemistry, and have an aptitude for it, should be counseled by some one really interested in "selling" chemistry and well-qualified to show students the personal satisfactions and rewards from making a career in chemistry.

Also, it is recommended that the high school student with science talent be encouraged to acquire an adequate mathematical background for a career in science. Algebra and plane geometry, at least - trigonometry, if possible - should be diligently pursued by him. At the same time, he should receive adequate training in written and oral expression.

It is urgently recommended that when students take general chemistry in college, they have the very best classroom and laboratory teachers available. This does not mean having a professor whose sole qualification is knowledge of the subject matter of chemistry, important as that is. The best freshman chemistry teacher is enthusiastic about chemistry and has the ability to inspire students. He should be friendly and helpful. He should be able to gear instruction in the theory of general chemistry to the level of beginning students.

The very best college teacher of general chemistry should also be able to speak and understand English well. There have been complaints from Oklahoma State University students about inability to communicate with foreign laboratory instructors. The writer believes in promoting friendly relations between nations but not at the expense of little or no learning on the part of students in the chemistry laboratory. It is urgently recommended that all foreign students be required to speak English fluently to receive consideration for appointments as graduate assistants in chemistry.

Recommendations about Persistence

Part of what has been recommended for increasing the number of students selecting chemistry as a major can be repeated for increasing the number of students persisting in chemistry.

The very best classroom and laboratory teachers available should teach freshman and sophomore chemistry courses. Once students are well-grounded in general and analytical chemistry and are half-way to their goal of a bachelor's degree in chemistry, they are more likely to survive than if they encounter poorer teachers in the first two years of college chemistry.

Opportunity for remedial work in mathematics should be given students who need it. A number of students starting to major in chemistry thought they had the necessary mathematical background, but later found to their dismay that they were poor in mathematical ability. Hence, they discontinued majoring in chemistry.

Laboratory conditions should be improved. Students spoke of "crusty" equipment in "crowded," "poorly-lighted," "superheated" laboratories "where storeroom personnel and that horrible dungeon of a building were enough to scare off the most devout student." It is hoped that this information might eliminate the "old dungeon" and Q-3. As for storeroom personnel, there was enough criticism to warrant instruction of these workers in better human relations.

Professors should reexamine teaching procedures to improve them. Those who instruct might well ask themselves, "Is it necessary to teach these particular things? Would it be better to spend more time on principles and generalizations and less time on details which students soon forget?" "I had to learn it" should not be the only reason for requiring that future students learn it.

A few young women majoring in chemistry at Oklahoma State University have found to their dismay that corporations do not wish to employ them as chemists. They are well-qualified, except they just happen to be the wrong sex. Consequently they have changed their major. If this is a common occurrence, women should be advised at the outset what to expect, rather than face disappointment their junior or senior year through no fault of their own. There is need for greater exchange of ideas on this subject between corporations hiring chemists and college departments of chemistry, so that better advisement can be given women wishing to major in chemistry.

It is sincerely hoped that this study will be as valuable to the members of the department of chemistry at Oklahoma State University as it has been and will continue to be to the writer throughout his active life as a chemistry professor. It is also hoped that the value of this study will not be confined to the Oklahoma State University campus and to the writer. May the results obtained and the pattern of study used here be instrumental in causing more American students, wherever they may be found, to select and persist in chemistry as an area of specialization.

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APPENDIX A

Mailing List for Letters to Presidents of Land Grant Colleges in the United States

MAILING LIST FOR LETTERS TO PRESIDENTS OF LAND GRANT COLLEGES IN THE UNITED STATES

1. Dr. Ralph B. Draughon, President
Alabama Polytechnic Institute
Auburn, Alabama

2. Dr. Richard A. Harvill, President
University of Arizona
Tucson, Arizona

3. Dr. John T. Caldwell, President
University of Arkansas
Fayetteville, Arkansas

4. Dr. Robert G. Sproul, President
The University of California
Berkeley, California

5. Dr. William E. Morgan, President
Colorado A. and M. College
Fort Collins, Colorado

6. Dr. Albert N. Jorgensen, President
The University of Connecticut
Storrs, Connecticut

7. Dr. John A. Perkins, President
University of Delaware
Newark, Delaware

8. Dr. J. Wayne Reitz, President
University of Florida
Gainesville, Florida

9. Dr. Omer C. Aderhold, President
The University of Georgia
Athens, Georgia

10. Dr. Donald R. Theophilus, President
University of Idaho
Moscow, Idaho

11. Dr. David D. Henry, President
University of Illinois
Urbana, Illinois

12. Dr. Frederick L. Hovde, President
Purdue University
Lafayette, Indiana

13. Dr. James H. Hilton, President
Iowa State College
Ames, Iowa

14. Dr. James A. McCain, President
Kansas State College
Manhattan, Kansas

15. Dr. Troy H. Middleton, President
Louisiana State University and A. and M. College
Baton Rouge, Louisiana

16. Dr. Herman Lee Donovan, President
University of Kentucky
Lexington, Kentucky

17. Dr. Arthur A. Hauck, President
University of Maine
Orono, Maine

18. Dr. Wilson H. Elkins, President
University of Maryland
College Park, Maryland

19. Dr. Jean Paul Mather, President
University of Massachusetts
Amherst, Massachusetts

20. Dr. John A. Hannah, President
Michigan State College
East Lansing, Michigan

21. Dr. James L. Morrill, President
University of Minnesota
Minneapolis, Minnesota

22. Dr. Ben F. Hilburn, President
Mississippi State College
State College, Mississippi

23. Dr. Elmer Ellis, President
The University of Missouri
Columbia, Missouri

24. Dr. R. R. Renne, President
Montana State College
Bozeman, Montana

25. Dr. Clifford M. Hardin, Chancellor
University of Nebraska
Lincoln, Nebraska

26. Dr. Minard W. Stout, President
University of Nevada
Reno, Nevada

27. Dr. Edward D. Eddy, President
University of New Hampshire
Durham, New Hampshire

28. Dr. John W. Branson, President
New Mexico College of A. and M. Arts
State College, New Mexico

29. Dr. Deane W. Malott, President
Cornell University
Ithaca, New York

30. Dr. Carey H. Bostian, Chancellor
North Carolina State College of Agriculture and Engineering
Raleigh, North Carolina

31. Dr. Fred S. Hultz, President
North Dakota Agricultural College
Agricultural College, North Dakota

32. Dr. Howard L. Bevis, President
Ohio State University
Columbus, Ohio

33. Dr. August L. Strand, President
Oregon State College
Corvallis, Oregon

34. Dr. Milton S. Eisenhower, President
The Pennsylvania State College
State College, Pennsylvania

35. Dr. Carl R. Woodward, President
University of Rhode Island
Kingston, Rhode Island

36. Dr. John W. Headley, President
South Dakota State College of Agriculture and Mechanic Arts
Brookings, South Dakota

37. Dr. Cloide E. Brehm, President
University of Tennessee
Knoxville, Tennessee

38. Dr. David H. Morgan, President
A. and M. College of Texas
College Station, Texas

39. Dr. Carl W. Borgmann, President
University of Vermont and State Agricultural College
Burlington, Vermont

40. Dr. Walter S. Newman, President
Virginia Polytechnic Institute
Blacksburg, Virginia

41. Dr. C. Clement French, President
State College of Washington
Pullman, Washington

42. Dr. Irvin Stewart, President
West Virginia University
Morgantown, West Virginia

43. Dr. Edwin B. Fred, President
University of Wisconsin
Madison, Wisconsin

44. Dr. George D. Humphrey, President
University of Wyoming
Laramie, Wyoming

45. Dr. Lewis W. Jones, President
Rutgers University
New Brunswick, New Jersey

46. Dr. R. F. Poole, President
Clemson Agricultural College
Clemson College, South Carolina

47. Dr. L. L. Madsen, President
Utah State Agricultural College
Logan, Utah

APPENDIX B

Letter of Transmittal to Presidents of Land Grant Colleges in the United States

OKLAHOMA

AGRICULTURAL AND MECHANICAL COLLEGE

School of Arts and Sciences
Stillwater

Department of Chemistry

February 22, 1956

Dr. Ralph B. Draughon, President
Alabama Polytechnic Institute
Auburn, Alabama

Dear Dr. Draughon:

The Department of Chemistry of Oklahoma A. and M. College is interested in the factors associated with selection of and persistence in chemistry as an area of specialization by college undergraduates.

We would greatly appreciate your selecting <u>one</u> staff member at your institution who you believe is well qualified to judge the relative importance of various factors in the selection of and the persistence in chemistry by undergraduates. These factors have been gleaned from the literature concerned with chemical education. This phase of the study includes every land grant college in the United States.

Results of the response to our check list will be used in interviewing our students this semester. Consequently, we would appreciate receiving as early as possible the name and address of the staff member you wish to designate.

Yours sincerely,

O. C. Dermer, Head

OCD:wd

APPENDIX C

Land Grant College Staff Members Who Replied to the 127-Item Rating Scale, Their Titles, and Institutions Represented

LAND GRANT COLLEGE STAFF MEMBERS WHO REPLIED TO THE 127-ITEM RATING SCALE, THEIR TITLES, AND INSTITUTIONS REPRESENTED

1. Dr. Fred W. Jensen, Head
   Department of Chemistry
   A. and M. College of Texas

2. Dr. Thomas D. O'Brien, Head
   Department of Chemistry
   Kansas State College

3. Dr. James E. Land
   Professor of Chemistry
   Alabama Polytechnic Institute

4. Dr. Arthur Fry, Administrative Secretary
   Department of Chemistry
   University of Arkansas

5. Dr. P. A. van der Meulen, Head
   School of Chemistry
   Rutgers University

6. Dr. Richard L. Barrett
   Professor of Chemistry
   New Mexico College of Agriculture and Mechanic Arts

7. Dr. E. C. Gilbert, Chairman
   Department of Chemistry
   Oregon State College

8. Dr. Walter S. Ritchie, Head
   Department of Chemistry
   University of Massachusetts

9. Dr. Lyle R. Dawson, Head
   Department of Chemistry
   University of Kentucky

10. Dr. Allen E. Stearn, Chairman
    Department of Chemistry
    University of Missouri

11. Dr. W. H. Cone, Chairman
Department of Chemistry
University of Idaho

12. Dr. Leo Brewer
Professor of Chemistry
University of California

13. Dr. Jack G. Calvert
Assistant Professor of Chemistry
The Ohio State University

14. Dr. Riley Shaeffer
Professor of Chemistry
Iowa State College

15. Dr. J. H. Wood
Professor of Chemistry
The University of Tennessee

16. Dr. Lathrop Roberts, Head
Department of Chemistry
University of Arizona

17. Dr. L. L. Quill, Head
Department of Chemistry
Michigan State University

18. Dr. J. C. Culbertson, Chairman
Department of Chemistry
State College of Washington

19. Dr. E. R. Schierz, Head
Department of Chemistry
University of Wyoming

20. Dr. Aaron J. Ilde
Professor of Chemistry
University of Wisconsin

21. Dr. Kenneth C. Kemp
Professor of Chemistry
University of Nevada

22. Dr. A. W. Laubengayer
Professor of Chemistry
Cornell University

23. Dr. W. J. Peterson, Head
Department of Chemistry
North Carolina State College

24. Dr. John W. Beamesderfer, Head
Department of Chemistry
University of Maine

25. Dr. Nathan L. Drake, Head
Department of Chemistry
University of Maryland

26. Dr. Paul R. Frey
Professor of Chemistry
Colorado A. and M. College

27. Dr. C. R. McLellan
Associate Professor of Chemistry
Louisiana State University and A. and M. College

28. Dr. Clyde Q. Sheely
Professor of Chemistry
Mississippi State College

29. Dr. Charles L. Lazzell, Head
Department of Chemistry
West Virginia University

30. Dr. John C. Bailar, Jr.
Professor of Chemistry
University of Illinois

31. Dr. R. C. Krug
Professor of Chemistry
Virginia Polytechnic Institute

32. Dr. P. C. Gaines, Head
Department of Chemistry
Montana State College

33. Dr. F. B. Schirmer, Jr., Head
Department of Chemistry and Geology
The Clemson Agricultural College
A. and M. College of South Carolina

34. Dr. James H. Looker
Associate Professor of Chemistry
University of Nebraska

35. Dr. Robert C. Brasted
Associate Professor of Chemistry
University of Minnesota

36. Dr. Theodore M. Burton
Professor of Chemistry
Utah State University

37. Dr. T. H. Whitehead
Professor of Chemistry
The University of Georgia

APPENDIX D

Letter of Transmittal to Land Grant College Educators

Selected by Their Presidents

OKLAHOMA
AGRICULTURAL AND MECHANICAL COLLEGE

School of Arts and Sciences
Stillwater

Department of Chemistry

March 5, 1956

Dr. James E. Land
Chemistry Department
Alabama Polytechnic Institute
Auburn, Alabama

Dear Dr. Land:

This department is studying the factors positively associated with selection of and persistence in chemistry as an area of specialization by college undergraduates. You have been designated by your college president as the staff member at your institution who is well qualified to estimate the relative importance of such factors.

For this study a factor is defined as one of the elements that contribute to produce a result. Positively associated means that the factor favors selection or persistence. Persistence is defined as the continuance on the part of the student to list chemistry as his major each time he enrolls in college.

In the pages which follow are listed 127 factors gleaned from the literature concerned with chemical education. For convenience the factors have been divided into two main categories:

(1) factors which favor the selection of chemistry as an area of specialization by college undergraduates, and
(2) factors which favor persistence in chemistry as an area of specialization by college undergraduates.

The first of these two categories has been further subdivided into factors connected with experiences of students in the elementary school, college, home, and with the public and government. Certain personal factors are also included. The factors of the second category have been subdivided into those connected with the college students' experiences in the classroom and laboratory. Certain personal factors, along with a few which have no common basis for classification are also included.

We would like for you to do the following two things:

(1) Indicate your opinion of the frequency with which each factor listed favors the selection of or persistence in chemistry.

(2) List and <u>rate</u> any additional factors pertinent to the above two categories, which you have encountered in your experiences. Space is provided at the end of each category for recording this information.

Results of the response to our check list will be used in interviewing our students this semester. Consequently, we would appreciate receiving an early reply from you.

One person in each land-grant college in the United States will be receiving a copy of this phase of the study. After all replies have been returned to us, data will be summarized. A copy of the findings will be mailed to you, if you wish.

Yours sincerely,

O. C. Dermer

OCD:wd

APPENDIX E

Sample Copy of 127-Item Rating Scale Sent to Land Grant College Educators Selected by Their Presidents

FACTORS WHICH FAVOR THE SELECTION OF CHEMISTRY AS AN AREA OF SPECIALIZATION BY COLLEGE UNDERGRADUATES

To the right of each of the factors listed are six blanks. By means of a check mark (✓) please indicate the frequency with which you think the factor always, usually, occasionally, seldom, or never favors the SELECTION of chemistry as an area of specialization by college undergraduates. There may be factors about which you have no opinion. If so, place a check mark in the sixth blank.

	Always	Usually	Occasionally	Seldom	Never	No opinion
I. Factors Connected with the Elementary School Experiences of Students						
(1) Adequacy of mathematics taught in the elementary grades	___	___	___	___	___	___
(2) Adequacy of science taught in the elementary grades	___	___	___	___	___	___
(3) Training of elementary teachers in mathematics	___	___	___	___	___	___
(4) Training of elementary teachers in science	___	___	___	___	___	___
(5) Moderate size of classes in elementary schools	___	___	___	___	___	___
(6) Adequacy of equipment to teach science in elementary schools	___	___	___	___	___	___
(7) Efforts made from the fifth through the eighth grade to detect and encourage students with science talent to select science and mathematics courses in high school	___	___	___	___	___	___
II. Factors Connected with the Secondary School Experiences of Students						
(1) Adequacy of mathematics taught in the secondary schools	___	___	___	___	___	___
(2) Adequacy of science taught in the secondary schools	___	___	___	___	___	___
(3) Quality of the background in chemistry obtained by high school students	___	___	___	___	___	___

	Always	Usually	Occasionally	Seldom	Never	No opinion
(4) Amount of college preparatory work other than mathematics and science taught to gifted students in secondary schools						
(5) Adequacy of English courses taught in high school						
(6) Training of mathematics teachers in the secondary schools						
(7) Training of physics, biology, and general science teachers in the secondary schools						
(8) Academic qualifications of high school chemistry teachers						
(9) Moderate size of classes in secondary schools						
(10) Efforts by teachers to require good students to work up to their abilities						
(11) Ability grouping of students in high school						
(12) Teaching of separate classes for college-bound students during the last year of high school						
(13) Extension of the high school academic year to ten or eleven months						
(14) Use of the individual laboratory method in teaching high school chemistry						
(15) Use of the demonstration method in teaching high school chemistry						
(16) Attitudes of high school counselors toward the pursuit of chemistry						

	Always	Usually	Occasionally	Seldom	Never	No opinion
(17) Efforts made to detect and encourage college-bound students with science talent to select chemistry in college						
(18) Students' having had general science in high school						
(19) Students' having had biology in high school						
(20) Students' having had physics in high school						
(21) Students' having had chemistry in high school						
(22) Students' having had algebra in high school						
(23) Students' having had geometry in high school						
(24) Students' having had trigonometry in high school						
(25) Election of science and mathematics courses by college-bound students even though they think such choices might lessen their chances for scholarships						

III. Factors Connected with College Experiences of Students

	Always	Usually	Occasionally	Seldom	Never	No opinion
(1) Training of college chemistry teachers						
(2) Abilities of freshman chemistry teachers to inspire students						
(3) Attitudes of chemistry storeroom employees toward students						
(4) Emphasis by freshman chemistry teachers on the national importance of majoring in chemistry						

		Always	Usually	Occasionally	Seldom	Never	No opinion
(5)	Emphasis by freshman chemistry teachers on the personal satisfactions and rewards from making a career of chemistry	___	___	___	___	___	___
(6)	Friendly and helpful attitudes on the part of college chemistry teachers toward their freshman students	___	___	___	___	___	___
(7)	Abilities of chemistry laboratory instructors to speak and understand English well	___	___	___	___	___	___
(8)	Abilities of professors to gear instruction in the theory of general chemistry to the level of beginning students	___	___	___	___	___	___
(9)	Conflict between chemistry course schedules and jobs essential to students' staying in college	___	___	___	___	___	___
(10)	Adequacy of advisement of college students with regard to chemistry as their major	___	___	___	___	___	___
(11)	Moderate size of laboratory classes in chemistry, especially during the freshman year	___	___	___	___	___	___
(12)	Adequacy of equipment in college chemistry laboratories	___	___	___	___	___	___
(13)	Condition of buildings housing chemistry laboratories	___	___	___	___	___	___
(14)	Safety records in college chemistry laboratories	___	___	___	___	___	___
(15)	Low departmental standards for majoring in chemistry	___	___	___	___	___	___
(16)	High departmental standards for majoring in chemistry	___	___	___	___	___	___

	Always	Usually	Occasionally	Seldom	Never	No opinion
(17) Cooperation between colleges and high schools to promote training of future chemists	___	___	___	___	___	___
(18) Consistent policy among members of a given chemistry department with reference to selection and recruitment of chemistry majors	___	___	___	___	___	___
(19) "Scuttlebutt" from other college students concerning the degree of difficulty of chemistry courses	___	___	___	___	___	___
(20) Amount of outside preparation involved in the study of chemistry	___	___	___	___	___	___
(21) Necessity of spending three hours in chemistry laboratory work per week for one semester-hour credit	___	___	___	___	___	___
(22) Feelings of students about their own abilities to deal with mathematics needed in chemistry	___	___	___	___	___	___
(23) Amount of emphasis in general chemistry on prerequisites to other chemistry courses	___	___	___	___	___	___
(24) Amount of emphasis in general chemistry on the cultural aspects of chemistry	___	___	___	___	___	___
IV. Factors Connected with Home Experiences of Students						
(1) Parental advisement and encouragement to major in chemistry	___	___	___	___	___	___
(2) Use of chemistry sets as gifts when children	___	___	___	___	___	___

	Always	Usually	Occasionally	Seldom	Never	No opinion
(3) Presence of good books and magazines on science at home	___	___	___	___	___	___

V. Factors Connected with Students' Experiences with the Public and Government

	Always	Usually	Occasionally	Seldom	Never	No opinion
(1) Encouragement from peers to select chemistry as an area of specialization	___	___	___	___	___	___
(2) Advisement and encouragement of promising young people by chemists and organizations of chemists to enter chemistry as a career	___	___	___	___	___	___
(3) Attention given by organizations of people other than chemists to the "catastrophic decline in many schools in enrollments (in science and mathematics) and teaching competence in science and mathematics"	___	___	___	___	___	___
(4) Awareness by the general public of the critical need for more chemists	___	___	___	___	___	___
(5) Status of scientists in the "eyes of the public"	___	___	___	___	___	___
(6) Manpower needs in chemistry among the industries in their home states where students may desire to be employed and spend the rest of their lives	___	___	___	___	___	___
(7) Availability of monetary awards and scholarships for gifted students desiring to become chemists	___	___	___	___	___	___
(8) Participation in science award exhibits	___	___	___	___	___	___
(9) The possibility of military service exemptions for those who do major in chemistry	___	___	___	___	___	___

	Always	Usually	Occasionally	Seldom	Never	No opinion
VI. Personal Factors						
(1) Scientific interests of students	___	___	___	___	___	___
(2) Scientific aptitudes of students	___	___	___	___	___	___
(3) Sex of students	___	___	___	___	___	___
(4) Age of students	___	___	___	___	___	___
(5) General intelligence of students	___	___	___	___	___	___
(6) Students' feelings from "beholding the stature of the scientific giants of the past"	___	___	___	___	___	___
(7) Extent to which students particpate in extracurricular activities	___	___	___	___	___	___
(8) Extent of participation in social activities by students while attending college	___	___	___	___	___	___
(9) Reading abilities of students	___	___	___	___	___	___
(10) Abilities of students to express their thoughts both orally and in writing	___	___	___	___	___	___
(11) Degree of students' physical handicaps	___	___	___	___	___	___
REMINDER: Please list other factors which you think are pertinent to this category and rate them as above. Use space below						
(1)	___	___	___	___	___	___
(2)	___	___	___	___	___	___

	Always	Usually	Occasionally	Seldom	Never	No opinion
(3)						
(4)						
(5)						
(6)						
(7)						

FACTORS WHICH FAVOR <u>PERSISTENCE</u> IN CHEMISTRY AS AN AREA
OF SPECIALIZATION BY COLLEGE UNDERGRADUATES

To the right of each of the factors listed are six blanks. By means of a check mark (✓) please indicate the frequency with which you think the factor <u>always</u>, <u>usually</u>, <u>occasionally</u>, <u>seldom</u> or <u>never</u> favors <u>PERSISTENCE</u> in chemistry as an area of specialization by college undergraduates. There may be factors about which you have <u>no opinion</u>. If so, place a check mark in the sixth blank.

	Always	Usually	Occasionally	Seldom	Never	No opinion
I. Factors Connected with the College Students' Experiences in the Classroom and Laboratory						
(1) Training of chemistry professors in chemistry	___	___	___	___	___	___
(2) Training of chemistry professors in teaching	___	___	___	___	___	___
(3) Abilities of chemistry professors to inspire students	___	___	___	___	___	___
(4) Adequacy of equipment in college chemistry laboratories	___	___	___	___	___	___
(5) Condition of buildings housing chemistry laboratories	___	___	___	___	___	___
(6) Friendly and helpful attitudes on the part of chemistry professors toward their students	___	___	___	___	___	___
(7) Safety records in college chemistry laboratories	___	___	___	___	___	___
(8) Necessity of spending three hours in chemistry laboratory work per week for one semester-hour credit	___	___	___	___	___	___
(9) Policies about breakage costs in chemistry laboratory work	___	___	___	___	___	___
(10) Moderate size of laboratory classes in chemistry, especially during the freshman year	___	___	___	___	___	___
(11) Attitudes of chemistry storeroom employees toward students	___	___	___	___	___	___
(12) Abilities of chemistry lecturers to use readily understood English	___	___	___	___	___	___
(13) Abilities of chemistry laboratory instructors to speak and understand English well	___	___	___	___	___	___

	Always	Usually	Occasionally	Seldom	Never	No opinion
(14) Abilities of professors to gear instruction in the theory of general chemistry to the level of the beginning student						
(15) The degree to which brilliant chemistry students are challenged to do the best of which they are capable						
(16) Emphasis by college professors on the national importance of majoring in chemistry						
(17) Emphasis by college professors on the personal satisfactions and rewards from making a career of chemistry						
(18) Emphasis on the disciplinary aspects in courses in general chemistry						
(19) Emphasis on the culutral aspects in courses in general chemistry						
II. Personal Factors						
(1) General intelligence of students						
(2) Sex of students						
(3) Age of students						
(4) Health of students						
(5) Students' feelings resulting from "beholding the stature of the scientific giants of the past"						
(6) Time put in by students on extra-curricular activities						
(7) Time spent in social activities by students while attending college						

	Always	Usually	Occasionally	Seldom	Never	No opinion
(8) Reading abilities of students						
(9) Abilities of students to express their thoughts both orally and in writing						
(10) Scientific aptitudes of students						
(11) Economic status of students						
(12) Over-all grade-point averages of students						
(13) Degree of students' physical handicaps						
(14) Frequency of out-of-town home visits by students						
(15) Scholastic standing of students in their high school graduating classes						
(16) Conflict between chemistry course schedules and jobs essential to students' staying in college						
(17) Students' having had high school chemistry						
III. <u>Miscellaneous Factors</u>						
(1) Parental advisement and encouragement to continue with a major in chemistry						
(2) Choice of major in chemistry in the freshman year						
(3) Choice of major in chemistry in the sophomore year						
(4) Choice of major in chemistry in the junior year						

		Always	Usually	Occasionally	Seldom	Never	No opinion
(5)	The possibility of military service exemptions for those continuing in chemistry as an area of specialization	___	___	___	___	___	___
(6)	Selectivity on the part of the department in accepting students for majoring in chemistry	___	___	___	___	___	___
(7)	Consistent policy among members of a given chemistry department with reference to selection and recruitment of chemistry majors	___	___	___	___	___	___
(8)	Opportunity during the freshman year to take remedial work, especially in mathematics	___	___	___	___	___	___
(9)	Concentration of the chemistry department upon students who comprise the "cream of the crop"	___	___	___	___	___	___
(10)	Adequacy of advisement for chemistry students after selection of chemistry as their major	___	___	___	___	___	___
(11)	Amount of outside preparation involved in the pursuit of chemistry as a major	___	___	___	___	___	___
(12)	"Scuttlebutt" from other college students concerning the degree of difficulty of advanced chemistry courses to be taken by chemistry majors	___	___	___	___	___	___

	Always	Usually	Occasionally	Seldom	Never

REMINDER: <u>Please list other factors which you think are pertinent to this category and rate them as above. Use space below.</u>

(1)	___	___	___	___	___
(2)	___	___	___	___	___
(3)	___	___	___	___	___
(4)	___	___	___	___	___
(5)	___	___	___	___	___
(6)	___	___	___	___	___

Date__________________________ Your signature______________________________

If you wish a copy of the findings of this phase of the study, please check here: ________ .

APPENDIX F

Tabular Summary of Responses by Land Grant College

Professors to the 127-Item Rating Scale,

Number of Respondents Thirty-Seven

TABULAR SUMMARY OF RESPONSES BY LAND GRANT COLLEGE PROFESSORS TO THE 127-ITEM RATING SCALE, SHOWING FREQUENCY, WEIGHTED SCORE, AND RANK OF EACH ITEM

1. Factors which favor the selection of chemistry as an area of specialization by college undergraduates

Item No.	Always	Usually	Rating Frequency* Occasionally	Seldom	Never	No Opinion	Weighted Score	Rank of Item
	+2	+1	0	-1	-2	---		
I_1	6	16	8	4	0	3	+24	25
I_2	5	16	14	1	0	1	+25	23
I_3	3	13	10	5	0	6	+14	45
I_4	4	12	16	2	0	3	+18	38½
I_5	1	6	4	14	1	11	- 8	67½
I_6	5	10	15	4	0	3	+16	42
I_7	8	16	9	0	0	4	+32	14½
II_1	8	20	7	1	0	1	+35	13
II_2	10	25	2	0	0	0	+45	6
II_3	6	27	1	2	0	0	+37	12

*Occasionally a respondent did not check a given item. Two respondents left out two entire pages each; another left out one page. Hence the total frequency does not always add to 37.

Tabular Summary (continued)

Item No.	Always	Usually	Rating Frequency Occasionally	Seldom	Never	No Opinion	Weighted Score	Rank of Item
	+2	+1	0	-1	-2	---		
II_4	1	10	16	7	0	2	+ 5	53½
II_5	2	5	8	16	3	2	-13	73½
II_6	4	14	13	3	0	2	+19	37
II_7	5	21	8	0	0	1	+31	16
II_8	7	20	5	0	1	3	+32	14½
II_9	0	7	14	7	0	8	0	60
II_{10}	3	21	12	0	0	0	+27	21
II_{11}	1	6	12	4	0	13	+ 4	55
II_{12}	2	10	8	5	0	11	+ 9	51½
II_{13}	0	0	1	13	2	20	-17	76
II_{14}	6	18	8	2	0	2	+28	19½
II_{15}	1	10	19	5	1	0	+ 5	53½
II_{16}	10	19	7	0	0	0	+39	9
II_{17}	9	20	6	0	0	1	+38	10½

Tabular Summary (continued)

Item No.	Always	Usually	Rating Frequency Occasionally	Seldom	Never	No Opinion	Weighted Score	Rank of Item
	+2	+1	0	-1	-2	---		
II_{18}	3	11	15	5	1	1	+10	50
II_{19}	1	3	14	11	3	4	-12	71½
II_{20}	3	14	15	3	1	0	+15	43½
II_{21}	4	30	2	0	0	0	+38	10½
II_{22}	8	12	10	5	1	0	+21	33½
II_{23}	5	12	6	11	1	1	+ 9	51½
II_{24}	3	11	8	12	1	1	+ 3	57
II_{25}	6	17	4	0	0	9	+29	18
III_{1}	11	23	1	1	0	0	+44	7
III_{2}	21	12	2	0	0	0	+54	2
III_{3}	0	4	16	11	2	3	-11	70
III_{4}	2	15	14	5	1	0	+12	47½
III_{5}	3	17	13	3	0	1	+20	35
III_{6}	17	13	5	0	0	0	+47	5

Tabular Summary (continued)

Item No.	Always	Usually	Occasionally	Rating Frequency Seldom	Never	No Opinion	Weighted Score	Rank of Item
	+2	+1	0	-1	-2	---		
III_{7}	7	17	7	4	1	1	+25	23
III_{8}	17	14	5	0	0	1	+48	4
III_{9}	1	1	16	11	4	4	-16	75
III_{10}	6	18	13	0	0	0	+30	17
III_{11}	4	18	10	3	0	1	+23	27½
III_{12}	3	21	9	4	0	0	+23	27½
III_{13}	4	13	13	6	0	1	+15	43½
III_{14}	1	3	12	17	3	1	-18	77½
III_{15}	1	6	9	8	10	3	-20	79
III_{16}	4	16	13	2	0	1	+22	31
III_{17}	5	12	14	0	0	6	+22	31
III_{18}	6	10	14	3	0	3	+19	37
III_{19}	3	7	17	6	2	2	+ 3	57
III_{20}	3	6	19	9	0	0	+ 3	57

Tabular Summary (continued)

Item No.	Always	Usually	Occasionally	Rating Frequency Seldom	Never	No Opinion	Weighted Score	Rank of Item
	+2	+1	0	-1	-2	---		
III_{21}	2	4	19	11	0	1	- 3	63½
III_{22}	4	18	14	1	0	0	+25	23
III_{23}	1	7	17	9	0	3	0	60
III_{24}	1	3	17	11	3	2	-12	71½
IV_1	5	12	15	3	1	1	+17	41
IV_2	0	8	17	6	2	4	- 2	62
IV_3	7	12	12	2	1	1	+22	31
V_1	4	15	13	1	2	1	+18	38½
V_2	5	15	12	2	1	1	+21	33½
V_3	4	4	16	10	1	1	0	60
V_4	3	4	16	10	2	1	- 4	65
V_5	8	7	10	6	3	2	+11	49
V_6	3	11	15	5	0	2	+12	47½
V_7	9	10	13	3	1	0	+23	27½

Tabular Summary (continued)

Item No.	Always	Usually	Occasionally	Seldom	Never	No Opinion	Weighted Score	Rank of Item
			Rating Frequency					
	+2	+1	0	-1	-2	---		
V_8	7	10	17	1	0	1	+23	27½
V_9	2	5	11	11	3	2	- 8	67½
VI_1	23	12	1	0	0	0	+58	1
VI_2	17	19	0	0	0	0	+53	3
VI_3	2	16	10	5	1	2	+13	46
VI_4	0	1	15	11	4	5	-18	77½
VI_5	10	23	1	1	1	0	+40	8
VI_6	1	7	16	8	2	2	- 3	63½
VI_7	0	4	18	12	1	1	-10	69
VI_8	0	6	13	13	3	1	-13	73½
VI_9	9	15	7	3	1	1	+28	19½
VI_{10}	5	14	11	5	0	1	+19	37
VI_{11}	1	4	15	12	0	4	- 6	66

Tabular Summary (continued)

2. Factors which favor persistence in chemistry as an area of specialization by college undergraduates

Item No.	Always	Usually	Occasionally	Rating Frequency Seldom	Never	No Opinion	Weighted Score	Rank of Item
	+2	+1	0	-1	-2	----		
I_1	11	23	1	2	0	0	+43	5½
I_2	5	16	5	9	1	0	+15	20½
I_3	23	12	1	0	0	0	+58	1
I_4	6	20	10	1	0	0	+31	9
I_5	3	10	19	4	0	1	+12	23½
I_6	17	16	4	0	0	0	+50	3
I_7	0	5	6	20	5	1	-25	47
I_8	1	2	17	13	4	0	-17	43½
I_9	0	1	10	17	8	1	-32	48
I_{10}	2	11	18	4	0	1	+11	25
I_{11}	1	3	11	17	3	2	-18	45
I_{12}	9	15	9	3	0	1	+30	11
I_{13}	6	16	8	4	0	1	+24	15

Tabular Summary (continued)

Item No.	Always	Usually	Occasionally	Rating Frequency Seldom	Never	No Opinion	Weighted Score	Rank of Item
	+2	+1	0	-1	-2	----		
I_{14}	15	15	5	0	1	1	+43	5½
I_{15}	9	21	4	0	1	2	+37	7
I_{16}	2	10	20	4	0	1	+10	26
I_{17}	5	15	13	3	0	1	+22	18½
I_{18}	0	7	11	12	3	4	-11	42
I_{19}	0	2	12	18	2	3	-20	46
II_1	13	20	2	0	0	1	+46	4
II_2	1	7	18	8	1	2	- 1	30½
II_3	0	6	13	11	2	5	- 9	38
II_4	1	7	14	12	1	1	- 5	33½
II_5	1	6	14	13	1	0	- 7	36
II_6	0	6	18	9	3	0	- 9	38
II_7	1	4	18	10	3	0	-10	40½
II_8	8	18	6	4	0	0	+30	11

Tabular Summary (continued)

Item No.	Always	Usually	Occasionally	Rating Frequency Seldom	Never	No Opinion	Weighted Score	Rank of Item
	+2	+1	0	-1	-2	---		
II_{9}	3	20	8	3	0	2	+23	16½
II_{10}	21	15	0	0	0	0	+57	2
II_{11}	1	2	22	10	0	1	- 6	35
II_{12}	3	19	12	0	0	2	+25	14
II_{13}	1	3	16	13	1	2	-10	40½
II_{14}	0	6	10	11	0	8	- 5	33½
II_{15}	2	21	7	2	0	4	+23	16½
II_{16}	1	1	17	12	4	0	-17	43½
II_{17}	0	23	5	6	1	1	+15	20½
III_{1}	6	12	15	2	0	1	+22	18½
III_{2}	3	26	5	2	0	1	+30	11
III_{3}	5	19	11	1	0	1	+28	13
III_{4}	9	4	10	8	1	5	+12	23½

Tabular Summary (continued)

Item No.	Always	Usually	Occasionally	Rating Frequency Seldom	Never	No Opinion	Weighted Score	Rank of Item
	+2	+1	0	-1	-2	---		
III_5	1	4	15	13	1	3	- 9	38
III_6	4	9	13	7	1	3	+ 8	27
III_7	0	13	9	8	0	7	+ 5	29
III_8	2	7	13	10	1	4	- 1	30½
III_9	4	3	20	5	0	5	+ 6	28
III_{10}	9	19	6	1	0	2	+36	8
III_{11}	4	10	18	2	1	2	+14	22
III_{12}	3	2	19	10	0	3	- 2	32

RANKINGS AND RATINGS BY LAND GRANT COLLEGE PROFESSORS OF FACTORS ALLEGED TO BE ASSOCIATED WITH SELECTION OF CHEMISTRY BY STUDENTS

Item No.	Item	Weighted Score	Rank	Rating
VI_1	Scientific interests of students	+58	1	Always
III_2	Abilities of freshman chemistry teachers to inspire students	+54	2	Usually
VI_2	Scientific aptitudes of students	+53	3	Usually
III_8	Abilities of professors to gear instruction in the theory of general chemistry to the level of beginning students	+48	4	Usually
III_6	Friendly and helpful attitudes on the part of college chemistry teachers toward their freshman students	+47	5	Usually
II_2	Adequacy of science taught in the secondary schools	+45	6	Usually
III_1	Training of college chemistry teachers	+44	7	Usually
VI_5	General intelligence of students	+40	9	Usually
II_{16}	Attitudes of high school counselors toward the pursuit of chemistry	+39	9	Usually
II_{17}	Efforts made to detect and encourage college-bound students with science talent to select chemistry in college	+38	10½	Usually
II_{21}	Students' having had chemistry in high school	+38	10½	Usually
II_3	Quality of the background in chemistry obtained by high school students	+37	12	Usually

Rankings and Ratings (continued)

Item No.	Item	Weighted Score	Rank	Rating
II_1	Adequacy of mathematics taught in the secondary schools	+35	13	Usually
I_7	Efforts made from the fifth through the eighth grade to detect and encourage students with science talent to select science and mathematics courses in high school	+32	14½	Usually
II_8	Academic qualifications of high school chemistry teachers	+32	14½	Usually
II_7	Training of physics, biology, and general science teachers in the secondary schools	+31	16	Usually
III_{10}	Adequacy of advisement of college students with regard to chemistry as their major	+30	17	Usually
II_{25}	Election of science and mathematics courses by college-bound students even though they think such choices might lessen their chances for scholarships	+29	18	Usually
II_{14}	Use of the individual laboratory method in teaching high school chemistry	+28	19½	Usually
VI_9	Reading abilities of students	+28	19½	Usually
II_{10}	Efforts by teachers to require good students to work up to their abilities	+27	21	Usually

Rankings and Ratings (continued)

Item No.	Item	Weighted Score	Rank	Rating
I_2	Adequacy of science taught in the elementary grades	+25	23	Usually
III_7	Abilities of chemistry laboratory instructors to speak and understand English well	+25	23	Usually
III_{22}	Feelings of students about their own abilities to deal with mathematics needed in chemistry	+25	23	Usually
I_1	Adequacy of mathematics taught in the elementary grades	+24	25	Usually
III_{11}	Moderate size of laboratory classes in chemistry, especially during the freshman year	+23	27½	Usually
III_{12}	Adequacy of equipment in college chemistry laboratories	+23	27½	Usually
V_7	Availability of monetary awards and scholarships for gifted students desiring to become chemists	+23	27½	Usually
V_8	Participation in science award exhibits	+23	27½	Usually
IV_3	Presence of good books and magazines on science at home	+22	31	Usually
III_{16}	High departmental standards for majoring in chemistry	+22	31	Usually
III_{17}	Cooperation between colleges and high schools to promote training of future chemists	+22	31	Usually

Rankings and Ratings (continued)

Item No.	Item	Weighted Score	Rank	Rating
II_{22}	Students' having had algebra in high school	+21	33½	Usually
V_2	Advisement and encouragement of promising young people by chemists and organizations of chemists to enter chemistry as a career	+21	33½	Usually
III_5	Emphasis by freshman chemistry teachers on the personal satisfactions and rewards from making a career of chemistry	+20	35	Usually
VI_{10}	Abilities of students to express their thoughts both orally and in writing	+19	37	Usually
II_6	Training of mathematics teachers in the secondary schools	+19	37	Usually
III_{18}	Consistent policy among members of a given chemistry department with reference to selection and recruitment of chemistry majors	+19	37	Usually
I_4	Training of elementary teachers in science	+18	38½	Occasionally
V_1	Encouragement from peers to select chemistry as an area of specialization	+18	38½	Occasionally
IV_1	Parental advisement and encouragement to major in chemistry	+17	41	Occasionally
I_6	Adequacy of equipment to teach science in the elementary schools	+16	42	Occasionally

Rankings and Ratings (continued)

Item No.	Item	Weighted Score	Rank	Rating
III_{13}	Condition of buildings housing chemistry laboratories	+15	43½	Occasionally
II_{20}	Students' having had physics in high school	+15	43½	Occasionally
I_{3}	Training of elementary teachers in mathematics	+14	45	Occasionally
VI_{3}	Sex of students	+13	46	Occasionally
V_{6}	Manpower needs in chemistry among the industries in their home states where students may desire to be employed and spend the rest of their lives	+12	47½	Occasionally
III_{4}	Emphasis by freshman chemistry teachers on the national importance of majoring in chemistry	+12	47½	Occasionally
V_{5}	Status of scientists in the "eyes of the public"	+11	49	Occasionally
II_{18}	Students' having had general science in high school	+10	50	Occasionally
II_{23}	Students' having had geometry in high school	+ 9	51½	Occasionally
II_{12}	Teaching of separate classes for college-bound students during the last year of high school	+ 9	51½	Occasionally
II_{4}	Amount of college preparatory work other than mathematics and science taught to gifted students in secondary schools	+ 5	53½	Occasionally
II_{15}	Use of the demonstration method in teaching high school chemistry	+ 5	53½	Occasionally

Rankings and Ratings (continued)

Item No.	Item	Weighted Score	Rank	Rating
II_{11}	Ability grouping of students in high school	+ 4	55	Occasionally
II_{24}	Students' having had trigonometry in high school	+ 3	57	Occasionally
III_{20}	Amount of outside preparation involved in the study of chemistry	+ 3	57	Occasionally
III_{19}	"Scuttlebutt" from other college students concerning the degree of difficulty of chemistry courses	+ 3	57	Occasionally
II_{9}	Moderate size of classes in secondary schools	0	60	Occasionally
III_{23}	Amount of emphasis in general chemistry on prerequisites to other chemistry courses	0	60	Occasionally
V_{3}	Attention given by organizations of people other than chemists to the "catastrophic decline in many schools in enrollments (in science and mathematics) and teaching competence in science and mathematics	0	60	Occasionally
IV_{2}	Use of chemistry sets as gifts when children	- 2	62	Occasionally
III_{21}	Necessity of spending three hours in chemistry laboratory work per week for one semester-hour credit	- 3	63½	Occasionally
VI_{6}	Students' feelings from "beholding the stature of the scientific giants of the past"	- 3	63½	Occasionally

Rankings and Ratings (continued)

Item No.	Item	Weighted Score	Rank	Rating
V_4	Awareness by the general public of the national need for more chemists	- 4	65	Occasionally
VI_{11}	Degree of students' physical handicaps	- 6	66	Occasionally
V_9	The possibility of military service exemptions for those who do major in chemistry	- 8	67½	Occasionally
I_5	Moderate size of classes in elementary schools	- 8	67½	Occasionally
VI_7	Extent to which students participate in extra-curricular activities	-10	69	Occasionally
III_3	Attitudes of chemistry storeroom employees toward students	-11	70	Occasionally
II_{19}	Students' having had biology in high school	-12	71½	Occasionally
III_{24}	Amount of emphasis in general chemistry on the cultural aspects of chemistry	-12	71½	Occasionally
II_5	Adequacy of English courses taught in high school	-13	73½	Occasionally
VI_8	Extent of participation in social activities by students while attending college	-13	73½	Occasionally
III_9	Conflict between chemistry course schedules and jobs essential to students' staying in college	-16	75	Occasionally

Rankings and Ratings (continued)

Item No.	Item	Weighted Score	Rank	Rating
II_{13}	Extension of the high school academic year to ten or eleven months	−17	76	Occasionally
III_{14}	Safety records in college chemistry laboratories	−18	77½	Occasionally
VI_4	Age of students	−18	77½	Occasionally
III_{15}	Low departmental standards for majoring in chemistry	−20	79	Seldom

RANKINGS AND RATINGS BY LAND GRANT COLLEGE PROFESSORS OF FACTORS ALLEGED TO BE ASSOCIATED WITH PERSISTENCE IN CHEMISTRY BY STUDENTS

Item No.	Item	Weighted Score	Rank	Rating
I_3	Abilities of chemistry professors to inspire students	+58	1	Always
II_{10}	Scientific aptitudes of students	+57	2	Always
I_6	Friendly and helpful attitudes on the part of chemistry professors toward their students	+50	3	Usually
II_1	General intelligence of students	+46	4	Usually
I_{14}	Abilities of professors to gear instruction in the theory of general chemistry to the level of the beginning student	+43	5½	Usually
I_1	Training of chemistry professors in chemistry	+43	5½	Usually

Rankings and Ratings (continued)

Item No.	Item	Weighted Score	Rank	Rating
I_{15}	The degree to which brilliant chemistry students are challenged to do the best of which they are capable	+37	7	Usually
III_{10}	Adequacy of advisement for chemistry students after selection of chemistry as their major	+36	8	Usually
I_4	Adequacy of equipment in college chemistry laboratories	+31	9	Usually
I_{12}	Abilities of chemistry lecturers to use readily understood English	+30	11	Usually
II_8	Reading abilities of students	+30	11	Usually
III_2	Choice of major in chemistry in the freshman year	+30	11	Usually
III_3	Choice of major in chemistry in the sophomore year	+28	13	Usually
II_{12}	Over-all grade-point averages of students	+25	14	Usually
I_{13}	Abilities of chemistry laboratory instructors to speak and understand English well	+24	15	Usually
II_9	Abilities of students to express their thoughts both orally and in writing	+23	16½	Usually
II_{15}	Scholastic standing of students in their high school graduating classes	+23	16½	Usually
III_1	Parental advisement and encouragement to continue with a major in chemistry	+22	18½	Usually

Rankings and Ratings (continued)

Item No.	Item	Weighted Score	Rank	Rating
I_{17}	Emphasis by college professors on the personal satisfactions and rewards from making a career of chemistry	+22	18½	Usually
I_2	Training of chemistry professors in teaching	+15	20½	Occasionally
II_{17}	Students' having had high school chemistry	+15	20½	Occasionally
III_{11}	Amount of outside preparation involved in the pursuit of chemistry as a major	+14	22	Occasionally
III_4	Choice of major in chemistry in the junior year	+12	23½	Occasionally
I_5	Condition of buildings housing chemistry laboratories	+12	23½	Occasionally
I_{10}	Moderate size of laboratory classes in chemistry, especially during the freshman year	+11	25	Occasionally
I_{16}	Emphasis by college professors on the national importance of majoring in chemistry	+10	26	Occasionally
III_6	Selectivity on the part of the department in accepting students for majoring in chemistry	+ 8	27	Occasionally
III_9	Concentration of the chemistry department upon students who comprise the "cream of the crop"	+ 6	28	Occasionally

Rankings and Ratings (continued)

Item No.	Item	Weighted Score	Rank	Rating
III_7	Consistent policy among members of a given chemistry department with reference to selection and recruitment of chemistry majors	+ 5	29	Occasionally
III_8	Opportunity during the freshman year to take remedial work, especially in mathematics	- 1	30½	Occasionally
II_2	Sex of students	- 1	30½	Occasionally
III_{12}	"Scuttlebutt" from other college students concerning the degree of difficulty of advanced chemistry courses to be taken by chemistry majors	- 2	32	Occasionally
II_4	Health of students	- 5	33½	Occasionally
II_{14}	Frequency of out-of-town home visits by students	- 5	33½	Occasionally
II_{11}	Economic status of students	- 6	35	Occasionally
II_5	Students' feelings resulting from "beholding the stature of the scientific giants of the past"	- 7	36	Occasionally
II_6	Time put in by students on extra-curricular activities	- 9	38	Occasionally
III_5	The possibility of military service exemptions for those continuing in chemistry as an area of specialization	- 9	38	Occasionally
II_3	Age of students	- 9	38	Occasionally

Rankings and Ratings (continued)

Item No.	Item	Weighted Score	Rank	Rating
II_7	Time spent in social activities by students while attending college	-10	40½	Occasionally
II_{13}	Degree of students' physical handicaps	-10	40½	Occasionally
I_{18}	Emphasis on the disciplinary aspects in courses in general chemistry	-11	42	Occasionally
I_8	Necessity of spending three hours in chemistry laboratory work per week for one semester-hour credit	-17	43½	Occasionally
II_{16}	Conflict between chemistry course schedules and jobs essential to students' staying in college	-17	43½	Occasionally
I_{11}	Attitudes of chemistry storeroom employees toward students	-18	45	Occasionally
I_{19}	Emphasis on the cultural aspects in courses in general chemistry	-20	46	Seldom
I_7	Safety records in college chemistry laboratories	-25	47	Seldom
I_9	Policies about breakage costs in chemistry laboratory work	-32	48	Seldom

APPENDIX G

Letter of Transmittal to Graduates

of Oklahoma State University

Stillwater, Oklahoma
June 27, 1956

Mrs. Bernadine Wold
2617½ Ellsworth
Berkeley, California

Dear Mrs. Wold:

"Why don't more college students select science as a major and graduate in it?"

Since reports show that Russia is now producing twice as many qualified scientists as the United States, the answer to this question is of major importance.

You can help answer the question. Last semester 165 students at Oklahoma A. and M. supplied information during interviews. Now a selected group of A. and M. graduates of the past four years are being contacted by letter.

All replies will be confidential. No name will be used in any report.

The department of chemistry of Oklahoma A. and M. has authorized me, a graduate student on leave from teaching chemistry at East Central State College, Ada, Oklahoma, to find out what factors favor the selection of and persistence in chemistry as an area of specialization by college undergraduates.

Will you please do the following things:

(1) Using experiences in your past association with fellow students, indicate on the next three pages your opinion of the frequency with which each factor listed has favored the selection of or persistence in chemistry.

(2) On the back of page 1 state briefly why you did or did not select chemistry as a major. (If you did not select it as a major, state your reason(s) for taking your first college course in chemistry.)

(3) If you declared chemistry as a major at least once when you enrolled, on the back of page 2 state briefly why you did or did not persist with chemistry as your major.

(4) On the back of page 3 suggest improvements which might be made in the chemistry department at Oklahoma A. and M. to attract and hold more chemistry majors.

Thank you for an early reply.

Yours sincerely,

Willis Decker

APPENDIX H

Sample Copy of the 45-Item Rating Scale Sent to Oklahoma State University Graduates of 1953 to 1956

FACTORS WHICH FAVOR THE SELECTION OF CHEMISTRY AS AN AREA OF SPECIALIZATION BY COLLEGE UNDERGRADUATES

To the right of each of the factors listed are six blanks. Using experiences in your past association with fellow students, by means of a check mark (✓) please indicate the frequency with which you think the factor always, usually, occasionally, seldom or never has favored the SELECTION of chemistry as an area of specialization by college undergraduates. There may be factors about which you have no opinion. If so, place a check mark in the sixth blank.

	Always	Usually	Occasionally	Seldom	Never	No opinion
1. Moderate size of classes in elementary schools	___	___	___	___	___	___
2. Efforts made from the fifth through the eighth grade to detect and encourage students with science talent to select science and mathematics courses in high school	___	___	___	___	___	___
3. Adequacy of English courses taught in the secondary schools	___	___	___	___	___	___
4. Adequacy of science taught in the secondary schools	___	___	___	___	___	___
5. Adequacy of mathematics taught in the secondary schools	___	___	___	___	___	___
6. Students' having had biology in high school	___	___	___	___	___	___
7. Students' having had chemistry in high school	___	___	___	___	___	___
8. Attitudes of high school counselors toward the pursuit of chemistry	___	___	___	___	___	___
9. Training of physics, biology, and general science teachers in the secondary schools	___	___	___	___	___	___
10. Academic qualifications of high school chemistry teachers	___	___	___	___	___	___
11. Quality of the background in chemistry obtained by high school students	___	___	___	___	___	___
12. Efforts made to detect and encourage college-bound students with science talent to select chemistry in college	___	___	___	___	___	___
13. Extension of the high school academic year to ten or eleven months	___	___	___	___	___	___
14. Friendly and helpful attitudes on the part of college chemistry teachers toward their freshman students	___	___	___	___	___	___

		Always	Usually	Occasionally	Seldom	Never	No opinion
15.	Training of college chemistry teachers						
16.	Safety records in college chemistry laboratories						
17.	Conflict between chemistry course schedules and jobs essential to students' staying in college						
18.	Abilities of freshman chemistry teachers to inspire students						
19.	Attitudes of chemistry storeroom employees toward students						
20.	Low departmental standards for majoring in chemistry						
21.	Extent to which students participate in extra-curricular activities						
22.	Abilities of professors to gear instruction in the theory of general chemistry to the level of beginning students						
23.	Amount of emphasis in general chemistry on the cultural aspects of chemistry						
24.	Extent of participation in social activities by students while attending college						
25.	Scientific interests of students						
26.	Scientific aptitudes of students						
27.	General intelligence of students						
28.	Age of students						

* * *

FACTORS WHICH FAVOR PERSISTENCE IN CHEMISTRY AS AN AREA OF SPECIALIZATION BY COLLEGE UNDERGRADUATES

To the right of each of the factors listed are six blanks. Using experiences in your past association with fellow students, by means of a check mark (✓) please indicate the frequency with which you think the factor always, usually, occasionally, seldom or never has favored PERSISTENCE in chemistry as an area of specialization by college undergraduates. There may be factors about which you have no opinion. If so, place a check mark in the sixth blank.

		Always	Usually	Occasionally	Seldom	Never	No opinion
1.	Adequacy of advisement for chemistry students after selection of chemistry as their major						

	Always	Usually	Occasionally	Seldom	Never	No opinion
2. Emphasis on the disciplinary aspects in courses in general chemistry	___	___	___	___	___	___
3. Emphasis on the cultural aspects in courses in general chemistry	___	___	___	___	___	___
4. Degree of students' physical handicaps	___	___	___	___	___	___
5. Abilities of chemistry professors to inspire students	___	___	___	___	___	___
6. Friendly and helpful attitudes on the part of chemistry professors toward their students	___	___	___	___	___	___
7. Attitudes of chemistry storeroom employees toward students	___	___	___	___	___	___
8. The degree to which brilliant chemistry students are challenged to do the best of which they are capable	___	___	___	___	___	___
9. Abilities of professors to gear instruction in the theory of general chemistry to the level of the beginning student	___	___	___	___	___	___
10. Training of chemistry professors in chemistry	___	___	___	___	___	___
11. Necessity of spending three hours in chemistry laboratory work per week for one semester-hour credit	___	___	___	___	___	___
12. Safety records in college chemistry laboratories	___	___	___	___	___	___
13. Policies about breakage costs in chemistry laboratory work	___	___	___	___	___	___
14. Adequacy of equipment in college chemistry laboratories	___	___	___	___	___	___
15. Conflict between chemistry course sched- and jobs essential to students' staying in college	___	___	___	___	___	___
16. Scientific aptitudes of students	___	___	___	___	___	___
17. General intelligence of students	___	___	___	___	___	___

* * *

<u>IMPORTANT REMINDER</u>: Please use the backs of pages 1, 2, and 3 for brief statements about why <u>you</u> did or did not <u>select</u> chemistry as a major, why <u>you</u> did or did not <u>persist</u> with chemistry if you selected it as a major, and suggestions for improvement of the chemistry department at Oklahoma A. and M. so that it may attract and hold more chemistry majors.

APPENDIX I

Tabular Summary of Responses by Oklahoma State University Graduates to the 45-Item Rating Scale, Number of Respondents Thirty-five

TABULAR SUMMARY OF RESPONSES BY GRADUATES OF OKLAHOMA STATE UNIVERSITY TO THE 45-ITEM RATING SCALE, SHOWING RATING FREQUENCY, WEIGHTED SCORE, AND RANK OF EACH ITEM

1. Factors which favor the selection of chemistry as an area of specialization by college undergraduates

Item No.	Always	Usually	Occasionally	Rating Frequency Seldom	Never	No opinion	Weighted Score	Rank of Item
	+2	+1	0	-1	-2	----		
1	1	6	10	4	7	7	-10	19
2	4	13	9	6	3	0	+ 9	16
3	0	6	5	14	5	5	-18	24
4	7	16	5	7	0	0	+23	11
5	5	16	8	6	0	0	+20	13
6	1	10	14	7	2	1	+ 1	17
7	8	20	6	0	1	0	+34	4½
8	6	12	11	1	2	3	+19	14
9	7	16	10	1	0	0	+29	8
10	5	15	13	1	0	1	+24	10
11	10	13	9	1	1	1	+30	7

Tabular Summary (continued)

Item No.	Always	Usually	Occasionally	Rating Frequency Seldom	Never	No Opinion	Weighted Score	Rank of Item
	+2	+1	0	-1	-2	---		
12	10	12	8	2	2	1	+26	9
13	1	0	4	5	10	15	-23	26½
14	12	12	8	2	0	1	+34	4½
15	8	20	6	1	0	0	+35	3
16	1	4	9	13	5	3	-17	23
17	1	1	14	12	6	1	-21	25
18	8	11	10	6	0	0	+21	12
19	2	3	11	12	5	2	-15	21½
20	1	1	3	15	9	6	-30	28
21	0	3	14	12	3	3	-15	21½
22	4	15	11	5	0	0	+18	15
23	1	6	18	5	2	3	- 1	18
24	1	1	10	16	5	2	-23	26½
25	18	10	6	1	0	0	+45	1

Tabular Summary (continued)

Item No.	Always	Usually	Occasionally	Rating Frequency Seldom	Never	No Opinion	Weighted Score	Rank of Item
	+2	+1	0	-1	-2	---		
26	16	11	8	0	0	0	+43	2
27	9	17	5	3	0	0	+32	6
28	1	4	12	7	5	3	-11	20
2. Factors which favor persistence in chemistry as an area of specialization by college undergraduates								
1	7	14	12	1	0	1	+27	7
2	1	6	11	9	3	5	- 7	12
3	1	9	14	6	1	4	+ 3	10
4	0	0	5	14	8	8	-30	15½
5	10	17	5	3	0	0	+34	4¼
6	8	19	8	0	0	0	+35	2½
7	3	5	14	10	2	1	- 3	11
8	7	18	7	3	0	0	+29	6

Tabular Summary (continued)

Item No.	Rating Frequency Always	Usually	Occasionally	Seldom	Never	No Opinion	Weighted Score	Rank of Item
	+2	+1	0	-1	-2	---		
9	3	16	9	5	1	1	+15	8
10	8	20	4	2	0	1	+34	4½
11	1	3	9	15	5	2	-20	14
12	0	2	8	14	9	2	-30	15½
13	0	0	7	19	9	0	-37	17
14	4	11	14	4	2	0	+11	9
15	0	0	19	11	3	2	-17	13
16	12	21	2	0	0	0	+45	1
17	7	22	5	1	0	0	+35	2½

RANKINGS AND RATINGS BY GRADUATES OF FACTORS ALLEGED TO BE ASSOCIATED WITH SELECTION OF CHEMISTRY BY STUDENTS

Item No.	Item	Weighted Score	Rank	Rating
25	Scientific interests of students	+45	1	Usually
26	Scientific aptitudes of students	+43	2	Usually
15	Training of college chemistry teachers	+35	3	Usually
7	Students' having had chemistry in high school	+34	4½	Usually
14	Friendly and helpful attitudes on the part of college chemistry teachers toward their freshman students	+34	4½	Usually
27	General intelligence of students	+32	6	Usually
11	Quality of the background in chemistry obtained by high school students	+30	7	Usually
9	Training of physics, biology, and general science teachers in the secondary schools	+29	8	Usually
12	Efforts made to detect and encourage college-bound students with science talent to select chemistry in college	+26	9	Usually
10	Academic qualifications of high school chemistry teachers	+24	10	Usually
4	Adequacy of science taught in the secondary schools	+23	11	Usually
18	Abilities of freshman chemistry teachers to inspire students	+21	12	Usually

Rankings and Ratings (continued)

Item No.	Item	Weighted Score	Rank	Rating
5	Adequacy of mathematics taught in the secondary schools	+20	13	Usually
8	Attitudes of high school counselors toward the pursuit of chemistry	+19	14	Usually
22	Abilities of professors to gear instruction in the theory of general chemistry to the level of beginning students	+18	15	Usually
2	Efforts made from the fifth through the eighth grade to detect and encourage students with science talent to select science and mathematics courses in high school	+ 9	16	Occasionally
6	Students' having had biology in high school	+ 1	17	Occasionally
23	Amount of emphasis in general chemistry on the cultural aspects of chemistry	- 1	18	Occasionally
1	Moderate size of classes in elementary schools	-10	19	Occasionally
28	Age of students	-11	20	Occasionally
19	Attitudes of chemistry storeroom employees toward students	-15	21½	Occasionally
21	Extent to which students participate in extra-curricular activities	-15	21½	Occasionally
16	Safety records in college chemistry laboratories	-17	23	Occasionally
3	Adequacy of English courses taught in secondary schools	-18	24	Seldom

Rankings and Ratings (continued)

Item No.	Item	Weighted Score	Rank	Rating
17	Conflict between chemistry course schedules and jobs essential to students' staying in college	-21	25	Seldom
13	Extension of the high school academic year to ten or eleven months	-23	26½	Seldom
24	Extent of participation in social activities by students while attending college	-23	26½	Seldom
20	Low departmental standards for majoring in chemistry	-30	28	Seldom

RANKINGS AND RATINGS BY GRADUATES OF FACTORS ALLEGED TO BE ASSOCIATED WITH PERSISTENCE IN CHEMISTRY BY STUDENTS

Item No.	Item	Weighted Score	Rank	Rating
16	Scientific aptitudes of students	+45	1	Usually
6	Friendly and helpful attitudes on the part of chemistry professors toward their students	+35	2½	Usually
17	General intelligence of students	+35	2½	Usually
10	Training of chemistry professors in chemistry	+34	4½	Usually
5	Abilities of chemistry professors to inspire students	+34	4½	Usually

Rankings and Ratings (continued)

Item No.	Item	Weighted Score	Rank	Rating
8	The degree to which brilliant chemistry students are challenged to do the best of which they are capable	+29	6	Usually
1	Adequacy of advisement for chemistry students after selection of chemistry as their major	+27	7	Usually
9	Abilities of professors to gear instruction in the theory of general chemistry to the level of the beginning student	+15	8	Occasionally
14	Adequacy of equipment in college chemistry laboratories	+11	9	Occasionally
3	Emphasis on the cultural aspects in courses in general chemistry	+ 3	10	Occasionally
7	Attitudes of chemistry storeroom employees toward students	- 3	11	Occasionally
2	Emphasis on the disciplinary aspects in courses in general chemistry	- 7	12	Occasionally
15	Conflict between chemistry course schedules and jobs essential to students' staying in college	-17	13	Occasionally
11	Necessity of spending three hours in chemistry laboratory work per week for one semester-hour credit	-20	14	Seldom

Rankings and Ratings (continued)

Item No.	Item	Weighted Score	Rank	Rating
4	Degree of students' physical handicaps	-30	15½	Seldom
12	Safety records in college chemistry laboratories	-30	15½	Seldom
13	Policies about breakage costs in chemistry laboratory work	-37	17	Seldom

APPENDIX J

Additional Remarks Made by Graduates on the Return Sheets of the 45-Item Rating Scale

ADDITIONAL REMARKS MADE BY GRADUATES ON THE RETURN SHEETS OF THE 45-ITEM RATING SCALE

Comments by Persistors

1. I was glad to see that something is being done at A. and M. about this situation. . . . My reasons for choosing chemistry as a major won't help you much. I fell back on it from pre-med because I was prevented financially from going on to med. school. But I would like to help you if I can. I think some sort of program should be instituted in the early grades of high school to stimulate an interest in the sciences. Show the students what a career in chemistry for instance leads to - the jobs that can be obtained, salaries, etc. Then find out which of the interested ones are capable and stay after them. Then the program should be intensified after the interested students enter college. Separate the ones who are interested in chemistry and the ones who are only required to take chemistry as a part of another curriculum. Push these people, help them, challenge them, <u>improve</u> the <u>equipment</u> and <u>laboratories</u> and your chemistry majors will multiply. Of course, what I have said entails a lot of expensive doing and the state will have to put up the money. But I think it can be done and I wish I had a full time job working on it myself, for the college. I was never approached from first grade through college and encouraged to major in any science. Nor were careers and the future ever explained to me. I was never "sold" science by anyone. Everyone had the attitude that if I wanted it, okay, and if I didn't, okay. Laboratories and equipment were always factors in my case. They talked me out of it if anything. Along with this, storeroom personnel were enough to chase anyone away. My instructors were always very well trained. They were good teachers of the subject. But they never seemed to be interested in the students. Nor did they try to persuade me to choose a career in chemistry. I think they should personally interview <u>every</u> student and give him a "sales talk" on chemistry. These are only the opinions of one person but they are forwarded to you very conscientiously and I hope they are of some value to you.

2. I selected chemistry as a major because I enjoyed my high school chemistry, and I could see a future for it. Also, high school aptitude tests showed that I had natural tendencies toward chemistry. I persisted in chemistry because the more I had it the more I enjoyed it. Also, the future kept looking more promising.

3. My own interest in chemistry began when I was eight or ten and got a small chemistry set for Christmas. I have expanded this set and "tinkered" with chemistry off and on ever since, usually making things or trying experiments from the directions given in "Chemistry for Boys" in the public library. I would say that this book and the quality and novelty of the experiments in it probably is what influenced me most to <u>select</u> chemistry. I enjoyed high school chemistry also and was fortunate in having a teacher who showed enthusiasm for the subject and showed great interest and encouragement to those in his classes who showed interest in chemistry. His course was quite well organized, well taught, of the proper degree of

difficulty for high school students, and with emphasis on the right things for an elementary course. This was probably the final deciding factor in my deciding to major in chemistry in college. I believe the manner of presentation of the information to be learned in chemistry is one of the most important factors determining whether a person stays in the field. Chemistry impresses and appeals to me as being something which builds up logically into an increasingly more complete structure, so that the more is added to and learned about this structure, the greater will be the possibility of predicting what will happen in new and different situations. If many important "bricks" are left out of the foundation and lower floors of this structure, not only will the upper floors be mighty wobbly, but the structure as a whole will be less pleasing (and perhaps, eventually, annoying) to the mind. So the fundamental <u>principles</u>, basic <u>concepts</u>, the laws, and in short, the beauty and symmetry of chemistry should be of the primary importance, especially in general chemistry, the specific factual information being used as illustrations of these principles, and <u>entirely secondary to them</u>. In line with this, I think that more of the type of problems requiring stimulating imagination and ingenuity in applying these principles should be used in general chemistry instead of the usual rote memory, formula juggling, and cranking answers out of math equations by replacing the letters with numbers. It's been conspicuous to me that most students stay in or get out of chemistry during or slightly after taking general chemistry. Some of this, of course, is due to the difficulty of the field, as is to be expected, but a lot of it is due to their first impressions of chemistry in these first two semesters. I believe, and predict, that if general chemistry is taught, above all, coherently - each new thing taught, insofar as possible, dovetailing with, and dependent on the preceding topics, and phenomena explained as to <u>why</u> they occur in terms of the principles learned that students will find chemistry more intellectually satisfying and less a mystery, more an adventure and discovery and less a memory recitation, and above all, more connected and complete, and less a disconnected series of "topics."

4. I selected chemistry as a major primarily as a result of the influence of my high school chemistry teacher. I persisted due to the encouragement of my college advisor.

5. In the A. and M. classrooms the teaching was good, but the laboratories did not have the facilities to encourage extra experimentation on the part of the student. In other words, most of the labs were a farce, as you usually had an old lab report to go by or else you used someone else's data due to inadequate data and equipment. I am presently employed in industry as a chemist and am quite aware of the shortage of scientists. The best remedy I can think of is more emphasis on the scientist as a professional man such as doctors and lawyers.

6. I was a pre-med student and wanted to obtain a college degree in addition to a medical degree. Because of finances I didn't go to medical school and therefore completed the requirements for a B.A. degree in chemistry at A. and M. The chemistry department at A. and M. didn't, as far as I could observe, take enough interest in their undergraduate students. They lack a good advisor program. I think that in addition to assistance in scheduling courses, an advisor program should include counseling and

screening, both by advisors and the Head of the Department. The department did nothing either to stimulate or encourage students in chemistry - this includes actual class and laboratory instruction.

7. I tried a major in dairy, then field crops, and finally decided my best grades were in chemistry - so switched to agricultural chemistry. I got a job in the Ag Chem lab and this helped to hold my interest. . . . The long lab session of general chemistry was definitely boring and having to stay after I was through with my work was greatly disliked. If I may mention names, Dr.______ presents a very interesting course, but one doesn't learn a lot of facts. Dr.______'s course is too factual and needs to be more interesting - a sort of cross between the two would be helpful. One of the greatest ways for OAMC to hold chemistry students would be to have a better looking lab - the quonset is poorly lighted and very poorly ventilated and this leaves a bad taste in the student's mouth.

8. I selected chemistry as a major because it was interesting to me, it offered job security, it offered some prestige, it fell in line with a latent desire to study medicine. I would have selected horticulture as my major but while in the air force I had a chance to attend a liberal arts school that offered chemistry and not horticulture, so I persisted in chemistry. Above a certain level, say in a student's junior or senior year his laboratory breakage should be subsidized to a degree.

9. I chose to major in chemistry not for the pure love of this field but because I wanted to obtain a degree in a scientific field before entering a professional (dental) school. I felt that chemistry would offer great opportunities if I were not chosen for dental college. In freshman lab and lab theory if A. & M. had instructors who knew what they were doing and could gain the respect of the students, much better results in attracting and holding chemistry students could be realized. Also, Q-3 is terrible.

10. I selected chemistry as my major because of a long interest in the subject, and I enjoyed my two courses in general chemistry. I persisted because I enjoyed the subject. Smaller classes in general chemistry, and more demonstrations with lectures would help to attract and hold more students in chemistry.

11. I felt the opportunities were good either in industry or teaching for chemistry majors. I persisted for the same reasons. Also, most of the professors made it interesting.

12. I selected chemistry because of an interest created in early high school and promoted by an excellent teacher in my senior year of high school. Also, it was promoted further by parents who allowed many raids on the trash cans behind the chemistry building at Oklahoma A. and M. and lab experiments in the basement lab. My persisting in it can best be explained by the feeling one gets after completing an experiment, a feeling of really accomplishing something.

13. Chemistry is a field of study which depends on facts to be solved and determined before it has been perceived physically (materially). This

was the main reason for my selecting and staying with chemistry.

Comments by Non-Persistors

1. I selected chemistry as a major in college, because even though I was in college for pre-med, I wanted a major. I felt that chemistry would be helpful in my medical education.

2. I entered college with plans to pursue a pre-dental curriculum. Had I failed to gain admittance to the professional school of my choice, I planned to continue in chemistry. No doubt progress has been made since I suffered through general chemistry in a superheated quonset lab., but vast improvement in the physical plant is basic in improving overall attractiveness. More emphasis should be placed on pure chemistry; and more funds and recognized authorities in the field should be utilized in chemistry without the shadow of the agriculture aspect. A more positive attractive program of presenting the future (in all its ramifications; organic, inorganic, biological, etc.) to prospective students should be used - rather than a drab bulletin posted behind the glass from "American Chemical," which means little to the freshman student loitering in the main lobby of the chemistry building awaiting the bell for class.

3. I chose chemistry as the most comfortable means to a definite end. The B.A. curriculum allowed me, as a pre-medical student, to have a definite major in a field more interesting than some, and at the same time it was not too demanding in its requirements so that I had a wide latitude in choosing non-required subjects in which I was interested or thought would aid me in my future education. I said "more interesting than some" since although I enjoy chemistry, I don't believe I would enjoy it (now or then) as my life's profession. My major was changed from chemistry to pre-medical sciences after I was admitted to medical school. The undergraduate chemistry major often remains unseen (as well as being unchallenged and dissatisfied) in a maze of mediocre and inadequate laboratory instruction, cook-book type of laboratory busy-work, and compromising courses which are geared to the average non-chemistry major.

4. I selected chemistry because I hoped to be a pharmacist and with my dad open a drugstore. I didn't know a lot about how to begin studying my first course in chemistry. The book scared me. I coasted through that four hours on what I knew from high school chemistry. I didn't make as good grade the second semester, though I worked harder. I decided if I continued dropping in grade each time I took a course I certainly wasn't qualified to continue. The department at A. and M. needs a few new instructors in the beginning classes whom the students can understand. Just last semester my husband completed his first course in chemistry as an engineering student at Okla. A. and M., and all year long he made it through the course by listening and learning from his graduate lab instructor. He and most of the fellows he knew in the course couldn't understand their instructor's speech.

5. I selected chemistry because of the opportunities available to the chemistry major. I did not continue because I did not have the scientific background. I was especially lacking in mathematics. I believe these

deficiencies were caused by attending a small high school in which the courses were not offered and the lack of counseling during my freshman year in college.

6. I originally selected chemistry because I had a scientific inclination, sought sufficient challenge to my own abilities, and chemistry was the most recent science course studied in high school. I did not persist because I was attracted to zoology by the nature of the material studied, had a prejudice against being required to take physics (later took physics as med school prerequisite and thoroughly enjoyed it), and disliked the endless necessity for use of math, the unending calculations.

7. I selected chemistry as a major because I did well with it in high school. It is conceivable that somewhere in grade school or at home I was induced to a liking of science and for this reason did better in high school. In grade school we did have to listen to a weekly program called "Science on the Air," a program sponsored by the Board of Education in Rochester, N. Y. I changed to chemical engineering because it seemed a perfect combination of chemistry and mathematics along with the fact I would not be working in a lab for the rest of my life. I think A. and M. should sponsor propaganda for elementary schools to try to build up interest in chemistry. In most high schools in Oklahoma a student does not even touch chemistry in his studies. Students coming to A. and M. just don't have an interest in chemistry. If some comedians were to teach chemistry in grade schools there would probably be an overflow of chemists.

8. I selected chemistry as a major because it seemed to strike a balance between what most interested me and what I could complete most quickly, considering my one year of pre-med taken earlier. I changed to chemical engineering because I heard from many sources that the financial rewards and employment opportunities were greater.

9. I selected chemistry as a major because of an interesting and successful high school course in chemistry. I did not persist because I almost flunked physics, though I did well in chemistry and math. Another factor was that I just felt that my studies in chemistry were taking too much time, in detriment to my social life. I don't think one can be a serious science student and a playboy both, and I was more interested in the latter at the time. In addition, I concluded I'd rather work with people than things so I changed to psychology. Although it did not influence my departure from the chemistry department that horrible dungeon of a building is enough to scare off the most devout student.

10. I began a major in chemistry because I liked it, but my father who is seventy-five years old requested help to manage farm business affairs, so I changed to agronomy and returned to my father's farm which neither of my brothers wished to do.

11. I started in chemistry but changed to chemical engineering because I did not plan to get a doctorate which seems to be requisite for any degree of success in chemistry. Also, I was more interested in applications rather than pure chemistry. Some of the instructors at A. and M. have gotten into deep and rather ancient ruts. They apparently do not realize that

many students will mirror the enthusiasm and imagination of their instructor. If an instructor reads each day's lecture from notes that are several years old, then that instructor cannot expect <u>any</u> interest in his course. Too many fall back into the security of their positions and lose the vitality that is so essential to overcoming mediocrity. This certainly is not true of all A. and M. professors but it covers a sufficient number to be rather discouraging to a student.

12. I started to major in chemistry but became convinced that a chemist should possess an introvertic personality. I did not have this type personality so changed to industrial engineering. At A. and M. the professors don't seem to encourage the profession of chemistry.

13. I started chemistry with a pre-med major in mind. I changed to medicine when accepted at med. school.

Comments by Non-Selectors

1. I took a variety of courses as a freshman and with the help of aptitude tests decided on a business career.

2. I did not major in chemistry because I didn't enjoy working in a lab. I took my first course because I thought I might want to be a science major. A. and M. chemistry department could use more adequate lab. facilities and do a better job with smaller classes, better teachers, and discussion questions on exams.

3. I took chemistry my freshman year because I was thinking of pre-med requirements. Later I selected vocal music as a major. I liked chemistry - took enough courses in it that I have a teaching field in it, but I do not wish to teach it.

4. As a freshman I had a field of specialization in mind for a major which required chemistry. Later I decided on a major which did not require any chemistry - so took no more of it.

5. I took chemistry to satisfy degree requirements. It was not the most interesting class I ever attended. It could be made more interesting by pointing out more applications of it to home problems.

6. I took chemistry because Arts and Sciences required it. I had had enough background to pass the entrance test, so I completed the requirement in one semester instead of two.

7. Perhaps the chief reason for not selecting chemistry as a major was that it was extremely dull. Probably another factor was my mediocrity in that field. My conscious purpose in taking eight hours of chemistry was that it was required for what I thought I wanted to major in - Wildlife Management. To attract more students to major in chemistry the labs should be made more comfortable - physically and psychically - better temperature control, lighting, ventilation and more cheerful supervision by employees.

8. I enjoyed chemistry but my interest lay in an adjoining scientific field. I took chemistry because I preferred it to a general science course and it was required for the major I had in mind.

9. I took chemistry because it satisfied a physical science requirement. I spent seven years there at Oklahoma A. and M. In my opinion, the majority of the teachers seem to think most students are "bums" trying to cheat a grade out of them. I have twenty-three hours credit for chemistry, and only three of those hours bring pleasant memories - you can see by this I'm bitter.

APPENDIX K

Report of Interviews with Undergraduate Students

REPORT OF INTERVIEWS WITH UNDERGRADUATE STUDENTS

The free responses given in this report are the more meaningful statements made by the undergraduates. The responses are tabulated under the broad categories used in the 127-item rating scale.

Interview Comments By Persistors, Non-Persistors, and Non-Selectors About Selection of Chemistry

Responses of Students Who Selected Chemistry as a Major and Persisted

Only one student out of the sixty-seven in this group indicated that elementary school experiences had much to do with his choice of chemistry as a major. He said,

> I feel that my interest in science developed as I went along in the grades. I had excellent elementary science teachers. . . . Later a home chemistry set and a high school course in chemistry clinched my decision to major in chemistry.

Eighteen of the sixty-seven indicated that factors connected with their secondary school experiences were largely responsible for their selection of chemistry as a major. Quotations from them are given below.

1. I enjoyed my chemistry course in high school. . . . I liked my teacher.
2. My high school teacher encouraged me to major in chemistry. . . . He took us on a field trip to a chemical plant so we could see what chemists do. It looked like what I would enjoy as a vocation.
3. I had a good high school chemistry course.
4. I liked high school chemistry and decided then to major in it. . . . The potential salary of a chemist appealed to me. . . . I think those of high school age can best be influenced to major in chemistry if the salary possibilities are stressed rather than telling them to do this to save our country.
5. The influence of my high school chemistry teacher made me decide on chemistry as a major.
6. Mainly my high school chemistry course and teacher were responsible

for my decision. It was clinched by doing a paper on a career in chemistry in the college freshman orientation course.

7. I had a course in high school chemistry which really got me interested. . . . One of my first college courses was with an excellent teacher. . . . That clinched it.

8. I found my high school chemistry course exciting. . . . I liked my teacher. He suggested I go to A. and M. and major in chemistry.

9. Chemistry in high school got me interested. . . . My parents helped me make up my mind between forestry and chemistry during August before beginning college. We decided on chemistry.

10. I had a very inspiring high school teacher in chemistry. He let me use study hall time to run experiments in the chemistry lab. He also let me have chemicals and equipment, so that I could set up a lab at my dad's filling station and experiment in my spare time.

11. I talked to my high school chemistry teacher and her husband, a college chemistry professor. They helped me decide to major in chemistry.

12. Three other boys and I had the run of the high school chemistry lab three days a week and could do anything we wanted to - we ran a lot of experiments which were more complicated than the ones usually done in high school lab.

13. I had a capable and inspiring high school chemistry teacher. . . . Two other boys and I could experiment three afternoons per week. We made explosives - and unknowns for each other. . . . I won third in chemistry at an inter-scholastic meet for high school chemistry.

14. I had a good high school chemistry teacher. . . . Also, some boys and I had a chemistry set at home to experiment with.

15. I had a very interesting and inspiring young man with a master's degree for a high school chemistry teacher. He made the course hard, but it was easy for me.

16. I had a good high school chemistry course. I liked it and decided to major in it.

17. My high school teacher encouraged me to enter chemistry.

18. I made up my mind to major in chemistry during my junior year in high school when I took chemistry.

Half of the sixty-seven (thirty-three) said they selected chemistry primarily because of college experiences. Their responses are given below.

1. I have speech and hearing defects. . . . The vocational rehabilitation

director at A. and M. gave me some tests. I was best in music and next best in business administration; but the director advised me to try science, my third best field, because my defects would be a handicap in music and business administration. . . . So the main reason I'm a chemistry major is that I was forced into it - because of physical defects.

2. I was majoring in chemical engineering, but my senior year I decided to become a minister. I switched to a chemistry major because I could get a degree faster.

3. I was a pre-med. . . . Couldn't see how I could finance my way through medical school, so I looked over my transcript and decided the next best thing would be to finish with a major in chemistry.

4. I was majoring in chemical engineering but got disgusted with the dean, so I switched to chemistry my senior year.

5. I was a pre-med., but I didn't make medical school, so I changed to chemistry as next best choice.

6. I really enjoyed my first college chemistry teacher. He joked all the way through chemistry class, but you learned some chemistry. He influenced me to major in it.

7. I started in chemical engineering, but I ran into a tough physics course - partly subject, partly professor - and decided I couldn't get physics; so I switched to a chemistry major.

8. I usually judge a course by the teacher. I had a good chemistry teacher at Oklahoma College for Women - made three A's there - and I have liked all my teachers at A. and M.

9. I took chemistry as a science requirement in the school of commerce. I had two very capable and inspiring college chemistry teachers. They sold me on chemistry, and I changed to a chemistry major because of them.

10. I took freshman chemistry at Okmulgee Tech. . . . I liked the chemistry professor there. . . . I had pre-dentistry in mind but decided if I didn't make dental college, I'd like to have something good to fall back on - I could think of nothing better than chemistry.

11. I started out to major in geology, but I learned I'd have to travel a lot, which I didn't like. . . . Since I had had successful experiences in college chemistry I decided to switch to it as a major.

12. I came to A. and M. planning to be a medical technician. . . . I did a paper in freshman orientation on this job and learned I wouldn't like it. . . . I saw a few papers on chemistry and thought I would like that. . . . I talked with the chemistry adviser before making up my mind. He seemed so helpful that I wanted him for my

adviser, so I decided to try chemistry.

13. I planned to be a doctor, but I changed my mind the second semester of my freshman year. I liked the chemistry which I had taken as a pre-med. and chose it as a major.

14. I thought I wanted to major in geology, but after doing an orientation paper on it, I decided I wouldn't like it. . . . I saw some papers on chemistry - liked the way it sounded and decided on it.

15. I started out as a pre-med. with a major in chemistry, then went into service. . . . While there, I saw something of what medicine was like and didn't want it. . . . After getting out, I worked for Phillips' Petroleum Company a while and decided on chemical engineering as a career. However, the Veterans' Administration wouldn't let me change to engineering, so I came back to school to complete a degree in chemistry.

16. I started out to major in agriculture, but two inspiring college chemistry professors made me change my mind. One of my professors didn't say, "Be chemists," but the way he presented it made you want to be.

17. I started to major in agriculture. . . . Had Dr._______ for chemistry teacher. He sold me on majoring in chemistry.

18. I started as a pre-med. with a major in chemistry to have a good-paying job to fall back on in case I didn't make med. school.

19. I started chemical engineering, but I couldn't stand those crazy chemical engineering tests. . . . For example, one time the class of twenty made two D's and 18 F's, so I switched to chemistry. The chemistry professors are better and more fair.

20. I went to St. John's University in Shanghai. There I tried chemistry and did not do so well. So I completed a B.S. in agronomy. . . . When I came to the United States and A. and M., I decided I was more mature and could handle chemistry, so I thought I would give it a try again.

21. I thought I wanted to major in forestry, but I took chemistry under Dr._______. . . . He changed my mind - sold me on chemistry.

22. I came to A. and M. to major in agriculture. . . . Took chemistry with Dr._______. He's a teacher and a half; he could teach spelling and make it an interesting subject.

23. I started in chemical engineering but learned my mathematical background was weak, so I changed to chemistry.

24. I had a chemistry set as a boy. . . . Took high school chemistry. . . . And my dad suggested chemistry as a good field, but I talked with college advisers before finally making up my mind to enroll in chemistry.

25. I took college chemistry while thinking about an engineer or a pre-med. and enjoyed the courses and liked the professors. . . . I studied chemistry with a fellow student who was majoring in chemistry. He also influenced me to select it as a major.

26. I came to A. and M. to major in pre-vet. . . . I had Dr.______ for general chemistry and liked him and the way he presented the subject so well I decided to major in chemistry.

27. I had a lot of chemistry at home working with a home chemistry set, but I started in engineering in college. . . . I didn't like working with machines so switched to chemistry.

28. I came to A. and M. to major in agriculture. . . . Had Dr.______ for freshman chemistry. . . . He influenced me to change my major to chemistry.

29. I decided to major in chemistry in spite of professors of chemistry at another college who make a lot of errors in teaching it.

30. My high school science teachers were coaches first and science teachers last. . . . They didn't influence me to select chemistry. . . . I started as a chemical engineer. . . . Decided I liked pure science rather than applied, so switched to chemistry.

31. I took V.A. tests and was told I would be good in science and mathematics. I thought I'd try chemistry, but I may switch to geology.

32. I started as a mechanical engineer, then changed to chemical engineering, and finally to chemistry. I like my chemistry professors better than engineering professors. They are more friendly and inspiring.

33. I started as an electrical engineer and had chemistry with a well-qualified, inspiring teacher. He influenced me to change to chemistry as a major.

Ten of the sixty-seven who selected chemistry and persisted cited home experiences as influencing them the most to select chemistry as a major. Their statements were:

1. When I was eight or ten years old, I got my first chemistry set. At the age of twelve or thirteen my dad bought me a deluxe set. I gathered other equipment and had a lab. in the basement at home. . . . . I took chemistry in high school under an inspiring and well-trained teacher, but I had already made up my mind to major in chemistry.

2. Dad was a science and mathematics teacher. I grew up in a science environment, doing home experiments in chemistry.

3. My father always talked a scientific career for me. . . . My brother was a chemical engineer. . . . I took high school chemistry and

enjoyed it very much, so my father encouraged me to major in chemistry.

4. I have an uncle who is a chemical engineer, a sister who is a medical technician, a brother who is a chemical engineer. . . . My uncle influenced me the most, however, to select chemistry. He said I wouldn't have any trouble getting a well-paying job.

5. Dad had a B.S. in chemistry and an M.S. in theology - he's now a minister. . . . He often performed marvelous experiments at home. . . . I had a very good high school chemistry teacher, too.

6. My first interest developed when I had a small chemistry set. Then my friend got a $25.00 set. I got to work with it, too.

7. My father, step-father, sister, brother, and good friend were all chemists. I never thought of anything else for a major.

8. Dad bought me some good chemistry sets, and I had the old chemistry books of dad's. . . . I had my mind made up to major in chemistry before taking high school chemistry.

9. When I was eight or nine dad bought some encyclopedias on science. I read them and did many experiments suggested in them. . . . Later I set up a home chemistry lab. and filled it with discarded glassware obtained from the trash barrels of the Oklahoma A. and M. chemistry building. One day I found a discarded letter in the barrel addressed to Dr._______, so I bare-footed it up to his office, told him who I was and said I was interested in chemistry. He talked with me quite a while and gave me a chemistry book which I have read many times.

10. My dad was a college chemistry professor. At the age of four or five he had me bending glass tubing and mixing chemicals to get beautiful colors. At five, I was calling the gas from pop bottles CO_2. Later he got me a nice home chemistry set. He never did say I ought to major in chemistry, but when I was a high school senior he gave me a chance to take chemistry with college students for high school credit to see whether I'd like it. He gave me no special privileges - like seeing the examination questions before he gave a test or even hinting what they would be - yet I was usually third or fourth from the top on each examination given the large class, and one time I made the highest score. I decided to begin college as a chemistry major.

Under the category of factors connected with students' experiences with the public and government, five of the sixty-seven were chiefly influenced by acquaintances to select chemistry as a major. Responses were:

1. A friend of mine - two years ahead of me - was a chemistry major. He influenced me to select it as a major.

2. Some of my friends were chemists. They encouraged me to major in it.

3. A friend of mine who was a year older thought I should give chemistry a try.

4. I lived among artists and hated them, so I went to what I thought was the other extreme - science. It isn't that I love chemistry more, but I hate it less.

5. While I was a pharmacist's mate in the service I worked around drugs. . . . A friend there was a chemist, and he used to talk about chemistry being a good field, so I decided to major in it when I got back from military duty.

Probably some of the responses classified under the above categories could have been shifted to other categories, but to the writer, they were placed where they seemed to fit best, taking all that was said during the interview into consideration.

Free Responses of Students Who
Selected Chemistry as a Major and
Did Not Persist

Not one of the twenty-four students in this group indicated that elementary school experiences had any unusual influence on his selection of chemistry as a major.

Half of the twenty-four said they selected chemistry primarily because of secondary school experiences. It may be noted here that twenty-seven per cent of those who selected chemistry and persisted indicated that factors connected with their secondary school experiences were largely responsible for their selection of chemistry as a major, whereas fifty per cent of those who selected chemistry but did not persist stated factors in the same category most influenced their selection of chemistry. Their responses follow:

1. I got interested in chemistry in high school where I had a very

good, well-qualified, inspiring teacher.

2. I had a good high school background for a chemistry major. My high school chemistry teacher urged me to major in chemistry, so I gave it a try.

3. I had a very good high school chemistry teacher - he had a doctor's degree (a junior college was connected with the high school). . . . He gave me some tests and told me the results indicated I should major in chemistry or mathematics. I chose chemistry. . . . I had had chemistry sets at home, too.

4. At the suggestion of a high school counselor, I chose to major in chemistry at college.

5. I took a course in high school physics taught by a chemistry major. The course was more chemistry than physics. . . . Aptitude tests taken in high school indicated I should choose mathematics or science. . . . Dad was a chemist so I finally decided on chemistry.

6. I had an inspiring high school chemistry teacher. He suggested I give chemistry a try when I got to college.

7. We had a chemistry club in the fifth grade. . . . I had chemistry sets as a boy. . . . But high school chemistry definitely made up my mind to major in chemistry.

8. I had a very interesting high school chemistry teacher. He got down on the level of students. We learned a lot of chemistry and had a good time doing it. I really didn't know what I wanted to do when I got to college, but I decided to give chemistry a try.

9. My high school chemistry teacher was very good. She urged me to major in chemistry. My parents were a little disappointed that I selected it.

10. I had a good high school chemistry course and a good instructor, but I made up my own mind to try chemistry.

11. My high school chemistry course was a pleasant experience, and I thought I'd like to major in it here at A. and M., so I gave it a try.

12. I really got interested in chemistry in high school. I had a teacher who was interested in me. He appointed me laboratory assistant. I used to go early and set out stuff for the day's experiment. I got a big bang out of doing that then.

Only four of the twenty-four said they selected chemistry primarily because of college experiences. Their responses were:

1. I came to A. and M. as a pre-med. I didn't like zoology, but I did like chemistry so I switched to a chemistry major. . . . I had had chemistry sets at home and also high school chemistry. . . . A friend and I used to make "bombs" and sell them.

2. Dad majored in commerce and wanted me to major in it, too. I tried it one semester and took chemistry as a required course. I had Dr. _______. He influenced me to change my major from commerce to chemistry.

3. I wanted to major in mathematics. . . . I had had math courses in the service which A. and M. refused to accept and apply on a math major. Since I wanted a B.S. the quickest way possible and had had the equivalent of general chemistry, I decided to major in chemistry.

4. I started out to be a pharmacist. . . . Dad was. But there was no such thing as a pharmacy major at A. and M., so I put down the nearest thing to it - chemistry.

Five of the twenty-four said that home experiences influenced them most to select chemistry as a major. Their statements are:

1. Having a home chemistry set and a sister who had majored in chemistry influenced me to give it a try.

2. I had two or three excellent home chemistry sets, including electrolysis apparatus. I got the idea that being a scientist meant being a chemist. I thought I wanted to be a chemist even before I got out of high school, 'though I never had high school chemistry.

3. The brother of my brother-in-law was a chemist. I talked with him about chemistry and decided to try a major in it.

4. My dad worked for an oil company and noticed how badly chemists were needed. He influenced me to try chemistry as a major.

5. My second cousin, who was a chemical engineer, bought me a chemistry set when I was nine years old. I liked to experiment with it. . . . I also had an uncle who was a chemist for Kraft Foods in my home town. I thought: they've got good jobs - that's what I want to do.

Under the category of factors connected with students' experiences with the public and government, three of the twenty-four were chiefly influenced by acquaintances to select chemistry as a major. Responses were:

1. My boy friend's dad was a chemistry teacher. We fixed up a lab in the granary and really got interested in chemistry.

2. I talked with a friend about what we were going to be. We decided to be chemists.

3. I had in mind being a veterinarian but wanted a bachelor's degree in science first. . . . A fellow working on his master's in chemistry roomed at our home. His influence made me decide on chemistry as a major.

Responses of Students Who Took Chemistry But Did Not Select It as a Major

Students' statements follow:

1. I took chemistry because it is required in geology, in which I thought I'd major. . . . I had had two home chemistry sets and enjoyed working with them. . . . I thought I'd like chemistry here, but Dr. _______ scared me so badly I've never got up enough nerve to take any more. . . . If I have to take any more chemistry I'll go somewhere else to take it. . . . I made a C, but I should have had an F. . . . I don't know and never knew any chemistry. . . . Professor _______ used four-syllable words. . . . Also, I couldn't stand _______ screaming across the laboratory at me calling me an ignoramous. . . . I've got feelings.

2. I took chemistry because I figured anything I went into would require it, but I didn't plan to major in chemistry. . . . I had_______ a full year. . . . He just read out of a syllabus. . . . I also had _______. He's just no teacher - very uninspiring. He may know it himself, but he can't get it across. He starts something, then says look out for some exception, then spends all hour talking about the exception. I've got a whole notebook full of nonsense notes.

3. I took chemistry because I knew I'd need it for engineering. . . . My high school teacher told me chemistry was a hard field - 90% flunk out - I was scared to major in it after what my high school teacher said. _______ was a very boring lecturer and got off the subject a lot; _______ would stop in the middle of a lecture and say, "If any of you know any congressmen, tell them we need a new chemistry building."

4. I was undecided my first semester whether to major in commercial art, mechanical engineering, or geology. I needed chemistry for two of them so I took it, giving "general" for my major. I had Dr._______ for 114 - he was really good, and I learned a lot - yet I didn't feel overworked. This time I have _______. . . . He's good, but more business. . . . I know he has a lot to cover, but it's not too interesting.

5. I took chemistry because I figured I would major in geology, and chemistry would be required. I had Dr._______; he lectures to himself. Now I have Dr._______; he holds one's interest. . . . The classes and labs are too crowded.

6. I took chemistry because I was thinking about majoring in forestry. I had Dr._______; he had about 100% attendance; he could really make it interesting.

7. I had a better course in high school chemistry than I had at A. and M. It was taught by a chemist from Germany who came over here and took some courses in education. He had good equipment, too. Here at A. and M. students sit through lectures, then go to lab and do experiments they never heard of (no connection with lecture), then take tests over some things they never had in lecture or lab.

8. I started out thinking about pre-med. - took chemistry for that.

9. I was figuring on being an X-ray technician when I first came to college - took chemistry for that. Later I decided on medical technician. I had_______; he read from a manuscript, but he was better than _______, who didn't speak loudly enough and didn't get down on the student's level. I might as well been home reading the book.

10. I started as a pre-med. and took chemistry for that. I had Dr._____; his lectures were sloppy - like he'd never looked at the book before coming to class. He could never balance an equation; after trying and failing he would say, "Well, that's not important anyway - it's the theory behind it that's important." He gave us an outline of the course at the first, but he never followed it. He's the worst teacher I ever had - for one who has a doctor's degree. The chemistry department is getting like the math department - only one man that's any good.

11. I was figuring on going into engineering and would need chemistry. . . . The labs were kinda crowded.

12. I took chemistry because I planned to get a degree in meteorology, and chemistry was required. . . . The chemistry testing program stinks - if one could get by without getting flunked for excessive absences, he could pass without going to class. . . . It's just a guessing game - eenie, meenie, minie, mo - eliminate the ridiculous answers, mark all the others, and make a C or B.

13. I had pre-vet. in mind when I took chemistry. . . . I hated that hot, crowded lecture room.

14. I took chemistry while I was thinking about majoring in geology. . . . I goofed off - mostly my fault - didn't crack a book and made F.

15. I knew I'd go into nursing, and I needed chemistry for it. I enjoyed chemistry lectures, but I had a foreign student for lab - she was difficult to understand - it would be better if lab instructors could speak and understand English well.

16. I thought I was going to major in zoology - I knew I would need chemistry for that. I got a lot out of my first course with Dr._____, but this time I have Dr._______. It's impossible to take notes in his

class - I'm on the back row, and I just read my book in class - I can't hear or understand what he says. I also have a foreign girl for a lab teacher - I can't understand her. I might have decided to major in chemistry if I hadn't got Dr.______ and Miss______ for teachers.

17. I was figuring on majoring in geology - hadn't indicated it yet on my enrollment card - and I needed chemistry for that. . . . They didn't teach anything in chemistry at A. and M. I hadn't had with my high school teacher and better. . . . They ought to cut down on those crowded classes.

18. I thought I might major in geology - wasn't sure - so I took chemistry as a requirement for geology. My lab instructor tried to impress his students with what he knew. Lab just wasn't interesting.

19. I changed from engineering to pre-med. - took chemistry for that with ______. He was no good. . . . notorious for writing equations on the board, never balancing them, and never telling what they meant. . . . On tests given all chemistry students, students who have had an instructor who had gone over everything thoroughly have the advantage over those who haven't had such a teacher. Instructors ought to make out tests for their own class.

20. I had in mind to major in geology when I took chemistry. I had ______ the first semester and ______ now, which is some improvement, but both go too fast. I've got a notebook full of incomplete sentences that have no meaning. I had ______ (a foreign student) for lab one semester - the way he presented it sorta antagonized people - some students went to Dr.______ about him.

21. When I came back from the service I wanted to review some courses in mechanical engineering, but that department couldn't see it that way so I enrolled in Arts and Sciences and reviewed some subjects anyway - took chemistry for engineering. I had ______ the first semester, really enjoyed chemistry and got a lot out of it, but the second semester I had ______. I'm not prejudiced and not by myself, but I didn't get anything out of it. He'd write equations on the board, not balance them, and erase them before you had time to copy them.

22. I wasn't sure what I wanted to major in when I took chemistry, but I needed it for both geology or natural science. There are not enough demonstrations in lectures - I like to see what they're talking about. . . . ______ shoots over students' heads and goes too fast - lots of guys sleep during his lecture - he knows his chemistry and seems to want to get it across but doesn't.

23. I thought I wanted to major in fire protection - needed chemistry for that. I had ______ (foreign student) for lab. . . . He was kinda hard to understand.

24. I started as pre-pharmacy - took chemistry for that.

25. I was thinking of pre-med. when I took chemistry. I had a good lecturer the first semester - made an A, but _______ was no good at all - made a D.

26. I took chemistry because I was thinking about being a doctor. I have _______ for lecturer. He shouldn't be teaching freshman chemistry - you can't learn anything - he probably has forgotten more chemistry than I'll ever know, but he shoots over our heads. I can't take notes in there - finally just opened my book and tried to underline what he said. . . . Labs are too crowded - I got a shirt ruined when a guy next to me shot acid on it out of a test tube.

27. I thought I was going to major in bacteriology and would need chemistry. _______ was too boring - pitched it under us - like explaining addition when everybody knows how to do it already.

28. When I enrolled I was just feeling around to see what I'd like - thought engineering or pre-dental. _______ advised that I take chemistry - said it fit into most things. . . . That four-hour lab about killed me.

29. I was actually figuring on a geology major at the time I took chemistry. I had Dr. _______. It was hard to understand his lectures. If you asked a question, often he acted confused and would get off onto something else, and you wouldn't know just where he went or what he came back to. . . . He was supposed to be smart and all that, but you couldn't follow his lectures very well.

30. I planned to take animal husbandry but took chemistry while I put "general" for my major. I liked chemistry, but I want to work for myself.

31. My adviser suggested that I take chemistry - that it would fit into whatever I wanted to do. I liked theory but hated to go to that crowded lab and its crusty equipment. . . . Seems like we could never finish the experiments in the time available.

32. I took chemistry at a time when I was looking forward to going into engineering.

33. My adviser suggested I take chemistry because it fits into lots of fields. I enjoyed it, but I have in mind being a wrestling coach and maybe turning out a champion. I'm just one of those dumb athletes who never could do well in science and math.

34. When I came to A. and M. I had in mind either teaching mathematics, majoring in petroleum engineering or accounting. Chemistry was needed for two, so I took it. . . . Was pretty hard to hear _______, and I could hardly read what he wrote.

35. I was more interested in soils science - thought I'd like to know more about soils so I took chemistry. I had _______, but I learned more chemistry studying the book at home than from his lectures.

36. I thought I wanted to major in agricultural education - knew I needed chemistry for that so enrolled in it. I had a foreign student for lab - didn't get much out of it. If I'd had Dr. _______ for lab, I might have majored in it.

37. When I got back from the service, I took some V.A. tests. They told me I ought to take engineering. I felt weak in math, so they advised me to enroll in Arts and Sciences and take all the engineering courses I could get - then transfer later to engineering if that's what I still wanted - so I did. . . . _______ went too fast.

38. Even though I did not put down a major, I had geology in mind when I took chemistry. I enjoyed the lab, but the theory was too tough for me.

39. I took chemistry at A. and M. while thinking about engineering as a major field.

40. I was planning to major in vocational home economics when I took chemistry. The chemistry lecture-room was the most unattractive lecture-room I've seen in my four years at A. and M.

41. I took chemistry thinking I wanted to major in natural science. I had _________ for lecturer. I followed him the first five or ten minutes - then I might as well have been home reading the book.

42. I had pre-pharmacy in mind when I put down "general" and took chemistry. I had Dr. _______, and I didn't know what was going on - took very few notes. A friend had Dr. _______ the same year, and she liked chemistry very much.

43. I took chemistry because I planned to major in either geology or geography. . . . The lecture classes were too crowded.

44. I took chemistry while thinking of pre-med. or med-technician. I think they should have all those who have had high school chemistry take it together and all those who haven't take it together - give the beginners a chance. . . . Also, the attitude in the "squirrel cage" should be improved - many helpers have the attitude: "I know this - why don't you?"

45. I had a friend taking forestry - thought I'd try it before deciding to major in it - chemistry was one of the first required courses. I liked the theory with Dr. _______, but not the lab with _______. I'm going to take Organic with _______. . . . You don't learn as much, but it's easier.

46. I thought I wanted to major in something dealing with zoology, and chemistry was needed to do that. Chemistry should not be taught like everybody taking it was going to major in it. My 124 teacher was the worst teacher I ever had - wandered around and talked about a lot of stuff we'd never use.

47. I took chemistry because I thought it would be needed in whatever field I finally decided to major in. . . . Chemistry would attract more students if classes were smaller, teachers better, and blackboards easier to read.

48. As a freshman I was undecided about majoring in geology or pre-med. I needed chemistry for both - so took it.

49. I took chemistry because I figured it would fit into some possible fields for a major. . . . Having to put up with foreign instructors is a crying shame - I'm not against foreigners, but I'm here to learn. I think all chemistry teachers should have some education courses - lots of them don't know how to teach.

50. I took chemistry thinking I might decide on pre-med. As chemistry is taught here at A. and M. I don't see how anyone who hadn't already picked chemistry as a major before he came here would ever select it after he came. People who have had high school chemistry are thirty points ahead of everybody - they ought to separate those who've had high school chemistry from those who haven't.

51. I was planning to be a nurse and knew I had to have chemistry to do that.

52. Needed for major I had in mind. . . . Had _______; he shot over our heads - started talking big stuff the first day. Got more out of _______'s class.

53. I took chemistry to satisfy the physical science requirement in Arts and Sciences. I just horsed around - wasn't interested in a major - interested in keeping out of the army. . . . Made a D in chemistry - first D I ever made - my own fault.

54. I took chemistry as a physical science requirement and I also figured I might go into engineering. I had _______ for freshman chemistry and also for a later course. He's too tough for freshman chemistry - shoots over their heads - I bet I didn't take two pages of notes all semester. He assumes you know more than you do. . . . A boy I knew had had high school chemistry, and he was having as much trouble as I was.

55. I took chemistry to satisfy a physical science requirement. Had Dr. _______; he was very boring - usually ten students were sleeping - I worked crossword puzzles and slept part of the time - he never seemed to get disturbed if students were rowdy or slept - just went on lecturing.

56. Took chemistry to satisfy a physical science requirement in Arts and Sciences. I had Dr. _______; he was really good. One thing I didn't like was a final exam using a national test. It lowered my grade from B to C. I believe I could have done better on one made out at A. and M.

57. My adviser looked at my high school transcript and said, "You haven't had much science - I'll put you in chemistry." I had Dr. _______. He's a smart man and knows his chemistry but he couldn't get down on the student's level. It was hard to hear him, too. . . . There were too many problems to work - just for a physical science requirement. It would be better if those who have had high school chemistry were put in classes by themselves.

58. I took chemistry to fulfill an eight-hour physical science requirement in Arts and Sciences. One of my lecturers would ask if those on the back row could hear. The other professor seemed disinterested and was harder to understand.

59. I worked off a physical science requirement in Arts and Sciences by taking chemistry.

60. I took chemistry for a physical science requirement.

61. I needed chemistry to satisfy a physical science requirement. . . . College chemistry seemed like just a lot of facts - like memorizing the dictionary - DRY.

62. I took chemistry for an eight-hour physical science requirement.

63. I had to have eight hours physical science, so took chemistry. . . . Why can't all who've had high school chemistry be separated from those who haven't had it? . . . I suggest cutting down on size of classes so students don't feel lost and can see and hear better and ask some questions. . . . I went up to the "squirrel cage" several times to get help - they knew it and seemed to wonder why you couldn't see it.

64. I took chemistry for a physical science requirement. . . . Had Dr. _______; he couldn't get down on our level. . . . Classes were too large.

65. Took chemistry to satisfy a physical science requirement. . . . Classes are too large - if there were 30 in class you could hear all that was said and get it. Now if you are on the first two or three rows you can hear O. K., but you couldn't hear on the back row - even with a loud speaker - classes would still be too big.

66. I took chemistry here for a physical science requirement. My Arts and Sciences' adviser didn't mention any other physical science than chemistry. . . . Classes are too large, and the room is too hot.

67. Physical science was required so I took chemistry. . . . Some of my fellow students thought they were coerced into taking chemistry and didn't like it.

68. I'd had a good course in high school chemistry - passed the 154 test and could have taken it. I liked both math and chemistry - decided

to take easy chemistry (114) and hard math (calculus) since my fraternity took lots of time. Had _______ the first semester - lots of sleeping in class. . . . If I hadn't had high school chemistry I would have been snowed.

69. I was thinking of being a medical technician and took 154 chemistry at the insistence of the Arts and Sciences' adviser. I liked it and thought about majoring in chemistry, but in the next course, I had to make centrifuge tubes - never could get two alike - and I'd burn my fingers - after two or three weeks I dropped the course. . . . I figured out I could take six hours of mathematics and economics and have time left over for the time I was putting in for four hours chemistry.

70. I had a good high school course in chemistry and thought I'd like more of it, so took it in college. . . . I had in mind getting into some part of the oil business - settled on geology. Those chemistry lectures were given under hot, stuffy conditions. . . . If someone were not really enthusiastic about chemistry, spending long, hot hours there could make him lose interest quickly.

71. I thought I wanted some science field for a major - so took chemistry - it would fit into any major chosen later.

72. I was slightly interested in geology when I took chemistry. If I had had chemistry in high school I'd probably have selected it as a major. . . Most chemistry professors go too fast.

73. I took chemistry for three reasons - thought I was going into forestry, for a physical science requirement, and for general education. I had Dr. _______; he's the best teacher I have had in all my college work, including graduate work. Chemistry isn't my field either. He could talk an hour on how to sharpen pencils and make it interesting.

74. I took chemistry as part of a liberal education which I desired. I felt like I'd missed out on some areas of education in high school and wanted to round out a liberal education.

Interview Comments by Persistors and Non-Persistors about Persistence in Chemistry

Responses of Students Who Selected Chemistry as a Major and Persisted

Forty-seven of the sixty-seven students in this group indicated that factors connected with their experiences in the classroom and laboratory were largely responsible for their persistence in chemistry as a major. A number of the persistors had some of the same unpleasant experiences as non-persistors, yet in most instances there was something else to counterbalance the unpleasant and cause them to continue with chemistry. However, in a few cases students indicated they were going to make a change in their major the next time they enrolled. Responses were:

1. I had _______ in general chemistry - he talked about everything but chemistry. I heard they got rid of him. . . . I made a D on a qual. test - that about broke my heart - I'll try to raise it to a C. . . . I'm not interested in big things - satisfied to be able to make an average living in chemistry. . . . "Scuttlebutt" has me worried about physical chemistry - I'm not doing well in physics. . . . I like plenty of room and time - crowded in general and qual. - wasn't in quant. - I liked that. . . . There's too much memory work in qual., and you don't know what to expect - study theory and then all lab on the exam.

2. I'm thinking about discontinuing chemistry - having trouble with math. - only had high school arithmetic - no algebra.

3. In college, Dr. _______ has let me do some experimenting on my own. . . . My parents have encouraged me to continue with chemistry.

4. I figure good teachers have influenced me most to stay with chemistry. I've felt at times like changing majors on account of physics and math.

5. I was a chemical engineer and switched to chemistry when I was a second-semester senior so I could get a degree faster and start training for the ministry. I think general chemistry is the "crap" of chemistry - students are really not interested until they take an advanced course. Physical chemistry makes you sweat and mop your brow, but you learn something interesting.

6. Young professors in college are sharp - you learn something. . . . My prime reason for liking a course is the teacher. . . . Storeroom employees are not very cheerful - act like they begrudge getting something for you - about have to get down and beg for it.

7. I switched to chemistry from chemical engineering my senior year - had trouble with the dean. . . . I never did have a foreign student for a lab instructor, but now that I am a lab-assistant, I have students come to me and beg just to sit in my quiz section so that they could learn something. . . . I don't see why they hire them.

8. I usually judge a course by the teacher. . . My chums, when told I'm majoring in chemistry, usually say, "Oh, you poor girl - I feel sorry for you - isn't it hard?". . . . I had one foreign lab. instructor - I felt it was a handicap.

9. I figured I'd have to work while going to dental college, so stayed with chemistry because I thought it would pay more and also help me in dentistry.

10. My first course in chemistry was rough - almost quit, but took quant. next year - made two A's - gave me confidence. Also, I got to work in bio-lab. - kept me interested.

11. When the going has gotten tough, I've thought of changing majors, but the thought of losing my adviser kept me from it. I had ______; he read off a syllabus - no one got anything out of his class. Dr. _______ makes mistakes, gets his exponents mixed up - cook-book chemistry. . . . No one sells chemistry as a career - just chemistry and keep you ten minutes overtime.

12. I like my adviser's attitude - he seems to be happy with his profession - he comes up at 7:00 to give us two hours on a one-hour exam. . . . I make good grades (all A's) - never felt like I wanted to major in anything else. . . . A friend of mine is taking general chemistry - seems to be choking on all they're trying to cram down - I took it slower and got more out of it.

13. My chemistry professors for the most part were excellent and inspiring. . . . I like lab work - even if I had to spend three hours in lab for no credit, it would be worth it. Time goes fast in lab.

14. Where I started as a chemistry major classes were small, and you could get individual help - I liked my work there. The profs here that I have had are all O.K.

15. While in high school I won three chemistry meets, including the State one at A. and M. . . . All chemistry professors at A. and M. are good ones and friendly.

16. My professors in chemistry have been friendly and helpful. . . . I've never felt like changing my major even thought I got a D in one course.

17. Some of my chemistry professors have been inspiring and excellent teachers.

18. I've had good teachers, and I've made good grades.

19. My first chemistry professor was really good - made you want to stay with chemistry, but now I have _______; he just looks at his watch and starts talking - I don't get much out of his lectures.

20. Professors have been helpful and easily approached for advisement. My job in the storeroom has taught me a lot and kept up my interest.

21. I started as a chemical engineer, but my chemistry professors were a lot more friendly and fair - so I have stayed with chemistry.

22. My first chemistry teacher was tops - the one I have now is hard to figure - no one seems to like the guy's teaching or can figure what he thinks is important - he's almost squelching my interest in chemistry.

23. At one school I was storeroom manager - it held my interest in chemistry. . . . I've had very good teachers all the way in college.

24. My first professor was really good - now the one I have asks insignificant, footnote types of questions on exams - he's hard to figure. . . . The storeroom employees seem like they want to make you buy a lot of stuff. . . . Laboratory hazards appeal to me - I sorta like the possibility of the unexpected. . . . My parents are encouraging me.

25. I've made good grades in college chemistry, so I've decided to stay with it. . . . Storeroom employees are lousy. . . . Profs here try to make courses too hard - one course ought to receive two and one-half times more credit than it does. . . . I'm interested in making money - a chemist's job will pay well.

26. I enjoyed chemistry 114 - had Dr. _______. Now I have _______, and I can't make heads or tails out of my notes. Also, I have a lab instructor who can't answer many questions put to him - he's not much help. I'm going to change majors. The math is tough, too. I had a foreign graduate student for a math instructor. He taught to the top students. . . . Also, I talked to a chemist at Ponca City - he said, "If two people applied for a chemistry job and one was a woman and better qualified than a man, the man would still be hired." . . . Chemistry is a man's world. . . . Friends say I'm not the type to be a chemist.

27. When I first started chemistry I had an excellent professor. Then I got _______; he expects the impossible and gives little instruction about what we're to do in lab - just: "Make a wash bottle and start your experiments." . . . You can't do all he expects of you in lab and it's do it or make an F in the course - so I'm dropping the course. He spends too much time in class on problems and then very little about them is asked on tests. He told us the test would be 80% theory and 20% lab - it was just the opposite. By his request he says, "No questions in theory - it is a waste of time." He keeps us after the bell, too, and it's hard to get to the next class on time.

28. I've stayed with chemistry a year, but I'm changing to physics. In 154 the balances were lousy, and my lab instructor wasn't well informed. I don't care for my adviser, and his course is a farce - I've slept in class or didn't go several times and still made A.

29. I've had excellent chemistry teachers thus far, but I'm poor in math.

I hope I can finish in chemistry though. I hate ______ for a math teacher - I was only in his class a few days and dropped it. When in a class of thirty some, seventeen finish and only seven pass, something is wrong with the teacher - it's not a 500 course - just a 100 in basic math.

30. I've stayed with chemistry because I hate it less than anything else.

31. I wanted to get in vet. school, but politics kept me out, so I finished a chemistry major. Then I made vet. medicine.

32. Chemistry professors here are helpful and friendly to all.

33. I feel chemistry professors here help poor students more than the "cream of the crop."

34. Well-qualified, inspiring college teachers have been the main reasons I've stayed with chemistry. One or two profs could use some education courses - their tests are ungodly.

35. ______ knows it but can't get it across - he spends a lot of class time on problems, and we've only had two problems on three hour-exams - he's not much as a teacher.

36. Chemistry professors at A. and M. are well-trained. A. and M. has a good set-up for teaching chemistry except for those darned quonsets.

37. My profs have been friendly and helpful. . . . My parents wanted me to major in a science.

38. A. and M. profs are tops. . . . Some labs are too long but interesting. Mother wanted me to be a doctor, but encourages me in chemistry.

39. That d_____ ______ - he gets up there frothing at the mouth, and his eyes get glazed. He gets chalk in both hands and starts in - you don't know what the h___ to expect. I study more in it than anything. . . . I've got to where I hate it. . . . I want to get my credit in it and get out of there.

40. I found A. and M. profs O.K., but I've taken some biology and found it easier, so I'm changing to a natural science major and plan to teach.

41. I've liked all my chem. profs thus far. Dr. ______ is the best thing that ever happened to this chemistry department.

42. I had a foreign student for a lab instructor. . . . He was very impatient - if you asked him a question more than once you were in for a good ___ - eating. When he asked a question and I couldn't understand him, I'd ask him to repeat the question once more. If I still couldn't understand his English, I'd say I didn't know rather

than have him repeat the question again. About twenty-five in the section tried to get another instructor for the class - went to Dr. _______ about it. I'm going to take some more chemistry next fall, but if I get _______ again, I'll change my major.

43. A. and M. chemistry profs are really excellent. . . . Only had one I couldn't stand - one day there was a fire in the Q-3 lab - I put it out, looked up, and this chem. prof was out of the building and half-way across the street. I got in my last four lab reports during exam week, but he gave me an "I", and I had to take the entire course over the next summer. Physical chemistry is really tough, but I'd stack any P-Chem. student up against any from another school - they wouldn't be any better - a lot is thrown at you, but 48 is an A, and some of it sticks.

44. I lost all the skin from both hands with an unknown, and my lab instructor said, "They haven't given that out in five years, but I thought you were a better man than that." One girl blew up an unknown, fused the wire gauze, blew an iron ring in six pieces and set the ceiling on fire - was that her fault? . . . They expect us to know more than we do in that course. Without any instruction or warning we're thrown into the lab and told to go to work. I dislike lab instructors who either don't know enough to give help or don't want to. . . . The main instructor ought to take care of the lab. . . . You never see him around.

45. My teachers at A. and M. have been helpful and friendly.

46. All profs here are the best - good instructors and approachable.

47. I persisted chiefly because I did well in my chemistry and liked my teachers.

Six of the sixty-seven persistors mentioned personal factors as being largely responsible for their persistence in chemistry. Their statements are:

1. I thought about being a veterinarian, but since I'm married and have a child, I decided I could complete chemistry in four years and be ready to make a good living for my family. I wasn't sure I'd be able to finance vet. school.

2. I stayed with chemistry because of the financial rewards it offered. Some labs are too long (about seven hours work in all) for one hour credit. The A. and M. chemistry department isn't consistent - this would squeeze some majors out.

3. I won third in chemistry in the State meet and won the A. and M. award in freshman chemistry. . . . Courses haven't been very dificult.

4. I had ______ in general chemistry; he followed the text pretty closely and poured it on - it's a good thing I had high school chemistry or I'd probably quit.

5. My choice for a vocation is medicine, and I figured chemistry would be a good field to fall back on if I didn't make med. school.

6. I'm staying with chemistry because I have a job in biochem. lab and can work my way through. . . . Also, I like the profs here - it's more like a student-student relationship than a student-professor.

Fourteen of the sixty-seven who persisted in chemistry gave responses which are placed in the miscellaneous category. Quotations from them are:

1. I'm interested in learning chemistry, and I don't mind the amount of time I have to put in to learn it. . . . I've heard some "scuttlebutt" about the difficulty of higher chemistry courses, but I think students telling that are just trying to show how smart they are.

2. After talking with my parents and chemistry instructors I've decided a chemistry major is best for an undergraduate degree. I plan to be a doctor and have been accepted by med. school, but I decided to wait another year and finish my degree in chemistry.

3. My chemistry adviser does a good job keeping one interested in chemistry. . . . My parents encourage me, too.

4. I took chemistry as a major to have a good-paying job to fall back on if I didn't make med. school. I didn't make it, so it looks like I figured right.

5. My parents have encouraged me to stay with chemistry.

6. An uncle of mine has kept my interest up - good job easy to find, etc. When I tell girl friends I'm majoring in chemistry they look at me like they thought I was crazy.

7. Advisement at A. and M. is adequate - anytime we have problems we're welcome to come in and discuss them. . . . I have a foreign student for a lab instructor. . . . He's hard to understand. . . . My lecturer shoots over my head most of the time - he's hard to follow.

8. My adviser at A. and M. sells chemistry - advisement at A. and M. is tops.

9. My parents have given me encouragement. . . . My first chemistry professor was excellent. . . . My second knows his chemistry, but he can't put it over.

10. Most of my family are chemists, so naturally I've never thought of anything else for a major - I'm doing all right in it - professors here are very fine and cooperative.

11. Since I decided against pre-med., my parents have encouraged me to continue in chemistry. I've had successful experiences, so have continued. . . . Some professors require too much outside time and lab work for the credit received. Some are good in presenting the subject matter and some are not.

12. My dad is a doctor but he OKed my decision to major in chemistry and backs me up 100%.

13. My parents have given me all the encouragement and backing in the world to continue with a major in chemistry. I'm taking _____ chemistry with Dr. _______ now. I'm the top student in there. . . . But Dr. _______ doesn't ask much over his lectures even though he said he would. I dry lab the preliminary experiments - that's the only way I can get everything done that he requires.

14. My parents have given me all the encouragement necessary.

Responses of Students Who
Selected Chemistry as a Major
and Did Not Persist

Twenty of the twenty-four non-persistors indicated that factors connected with their experiences in college classroom and laboratory were largely responsible for their non-persistence in chemistry. Their responses follow:

1. I made an F in college algebra and a WF in trig. - didn't think I could handle the math in chemistry. Also, my ____ chemistry teacher was very boring and hard to understand.

2. I got accepted in med. school and figured I was bettering myself to change from chemistry to medicine.

3. I got to thinking - there's too much time required in lab for the credit received. . . . I wanted to be my own boss, too, with unlimited opportunity, so I chose the retailing business. I think a chemist has to bury himself in his work too much - may be good for mankind, but I like to meet a lot of people.

4. My adviser bobbled the first year - didn't enroll me in any chemistry tho' I told him I was a chemistry major. I took an Arts and Sciences' required course with Dr. _______; he's the main reason I wanted out of Arts and Sciences. Seems like the A&S profs and personnel were aloof - not easily approached.

5. You have to spend too much time learning chemistry for the monetary reward. . . . I liked animal science better, so changed to vet. medicine. . . . Mathematics was a problem, too. . . . I made a B in college algebra, but that teacher scared me out of math.

6. I really didn't know what I was getting into to major in chemistry - poor advisement. . . . My physics teacher had a great deal to do with my changing majors - I couldn't see how he got his answers. . . . I figured if I couldn't get physics I had no business in chemistry.

7. I worked in the chemistry storeroom, and the stress and strain dealing with chemistry professors was the main factor which caused me to change. If the experiment went wrong, we got eaten out - also, profs would want something right away. I know two others who got disgusted with chemistry and changed because of storeroom experiences. My lack of spelling ability was also a handicap in organic chemistry where single letters often made a big difference in answers.

8. I started as a chemistry major but got into military service and was connected with radar work. I got interested in electrical engineering and figured I could make more with a B.S. there than with a B.S. in chemistry. . . . Chemistry teachers at A. and M. do not sell chemistry - they just say, "Study harder."

9. I made A's in chemistry, but the grade curve was always low - got a defeated feeling - couldn't make close to 100% - felt like I wasn't getting what I should even though I was making an A. Friends asked me, "Do you think chemistry is an occupation for women?". . . . Had to put in too much time learning chemistry. . . . Classes were too large - got lost in the crowd.

10. I made an F in algebra - decided I couldn't handle the math needed for chemistry, so I switched majors. . . . We were always fighting over the balances in chemistry 154 - didn't like that lab.

11. I decided I liked outdoor work more than indoors, so changed to geology, after talking with some geologists at home.

12. I wanted to major in math - had had several courses in the service, but they wouldn't accept them on my major. Wanted a B.S. as soon as possible so started in chemistry (they did accept eight hours of chemistry I'd had in the service). . . . After making 4.0 grade-point average for a year, including A in calculus and other tough courses, I talked with officials again - they decided to let me major in math and apply service credits to major, so I changed to a math major which was what I wanted in the first place.

13. I really didn't know what I wanted to do when I came to college and still don't - I've switched schools and majors three times. . . I hate math. . . . I was just a number in that chemistry - didn't know anybody, and the prof shot the chemistry to us with the attitude: "Get it or try something else."

14. I had trouble with math in college - figured advanced chemistry courses would get tougher as far as math goes. I talked with close relatives who are teachers and decided to teach science.

15. I didn't feel like I was ready to go to college my freshman year - went home every week-end - didn't study like I ought to. . . . I

like animal science better.

16. I went out for freshman basketball and belonged to a social fraternity my first year - took too much of my time - made C's and later a D and F. I wanted to be a vet. so switched to zoology. . . . Chemistry professors seem to have a "sink-or-swim attitude."

17. I started to major in chemistry, but I couldn't get into any section the first semester. . . . Then I went into service - got interested in electronics, so changed when I got back to college. . . . Chemistry classes were crowded.

18. I switched majors primarily because I disliked chemistry laboratory work and also, I made some low grades in chemistry before I settled down after going to the service, marrying, and having a child - you can see I made an F in physical chemistry the first time and an A the second. My parents didn't want me to quit school, but I didn't do much and had to quit.

19. I made an F in my first chemistry course as a chemistry major. . . . I had a foreign student for a lab instructor; he was hard to understand. . . . It was too crowded in theory and lab - I was just a number. . . . I went into service and while there decided to be an electrician or mechanic. I took chemistry last semester and had a girl from a foreign country for a lab teacher - I could understand her better than the American prof. who lectured to us. I like small classes - everybody is known and receives personal attention.

20. I got disgusted with the crowded conditions in Q-3. I had a lower locker - when I stooped down to get apparatus, occasionally I'd get something poured down my back. _______ gave me four zeros on tests I missed because I had to be away from class - wouldn't let me make up the tests, so I dropped the course. I'm not too good in math either.

Only one of the twenty-four non-persistors stated that personal factors were the main reasons for her discontinuing chemistry. Her statements are:

1. At the end of my junior year, with four hours C at Colorado University and nine hours A and nine hours B at A. and M., I talked with three representatives of commercial companies. They said there were just no opportunities for women chemists other than chemical library work. I was absolutely not interested in that, so I switched to education and the teaching of science and math. They talk about opportunities for women chemists, but when it comes right down to hiring women chemists employers don't do it.

Three of the twenty-four non-persistors gave reasons for quitting chemistry which were of miscellaneous nature. Their responses are:

1. I started to major in chemistry, then had to go to the service. While there, I met six guys who were majoring in architecture. I was a carpenter in the service, and I got the idea carpentry and architecture were about the same, so when I got out I switched to architecture.

2. I didn't finish my degree - got married - ten years later I decided to finish as soon as possible. Found out I could finish in education and teach science, so changed majors.

3. I had two summers' work in chem. labs. - just routine and uninteresting - met a chemical engineer there - he said if I could only get a B.S. degree, engineering was a better-paying field. . . . Then I went into service - I applied for a chem. lab job but was turned down. I got to thinking along electrical engineering and mechanical lines and when I came back decided on mechanical engineering. I've liked it; my grades in it are better than my chemistry grades, so I plan to stay with it.

APPENDIX L

Percentages of Persistors and Non-Persistors Stating That Certain Factors Were Associated With Their Selection of and Persistence in Chemistry as a Major

PERCENTAGES OF PERSISTORS AND NON-PERSISTORS STATING THAT CERTAIN FACTORS WERE ASSOCIATED WITH THEIR SELECTION OF CHEMISTRY AS A MAJOR

The factors and percentages are given below in order of decreasing percentage for the persistors. Percentages for non-persistors are given in parentheses to the right of the percentages shown for persistors.

1.	Use of chemistry sets as gifts when children	45%	(33%)
2.	Quality of the background in chemistry obtained by high school students	39%	(54%)
3.	Academic qualifications of high school chemistry teachers	33%	(54%)
4.	Abilities of freshman chemistry teachers to inspire students	25%	(4%)
5.	Parental advisement and encouragement to major in chemistry	21%	(8%)
6.	Encouragement from peers to select chemistry as an area of specialization	16%	(17%)
7.	Friendly and helpful attitudes on the part of college chemistry teachers toward their freshman students	13%	(4%)
8.	Abilities of professors to gear instruction in the theory of general chemistry to the level of beginning students	9%	(0%)
9.	Adequacy of science taught in the elementary grades	9%	(0%)
10.	Adequacy of advisement of college students with regard to chemistry as their major	7%	(4%)
11.	Advisement and encouragement of promising young people by chemists and organizations of chemists to enter chemistry as a career	6%	(0%)
12.	Presence of good books and magazines on science at home	6%	(0%)
13.	Adequacy of mathematics taught in the secondary schools	4%	(0%)

14.	Moderate size of classes in elementary schools	3%	(0%)
15.	Training of college chemistry teachers	3%	(0%)
16.	Scientific aptitudes of students	3%	(0%)
17.	Adequacy of mathematics taught in the elementary grades	3%	(0%)
18.	Adequacy of equipment to teach science in elementary schools	3%	(0%)
19.	Adequacy of science taught in the secondary schools	3%	(0%)
20.	Could get a degree faster by switching to chemistry	3%	(4%)
21.	Started something else as major and could not make it - too difficult	3%	(0%)
22.	Needed to work as chemist to pay way through dental school and could fall back on chemistry if did not make it	3%	(0%)
23.	Training of elementary teachers in science	2%	(0%)
24.	Degree of students' physical handicaps	2%	(0%)
25.	Attitudes of high school counselors toward the pursuit of chemistry	2%	(17%)
26.	Feelings of students about their own abilities to deal with mathematics needed in chemistry	2%	(0%)
27.	Switched to chemistry major because of trouble with the dean of engineering	2%	(0%)
28.	Failed to make medical school and changed from pre-med. to chemistry	2%	(0%)
29.	Changed to chemistry because of lack of funds to get degree of first choice	2%	(0%)
30.	Relative other than parent encouraged student	2%	(8%)
31.	Lived among artists - hated them - went to the other extreme, science, and selected chemistry	2%	(0%)

32.	Decided to major in chemistry in spite of college chemistry professors	2%	(0%)
33.	Started with some other major not found at A. and M. (pharmacy) and put down nearest thing to it - chemistry	0%	(4%)

PERCENTAGES OF PERSISTORS AND NON-PERSISTORS STATING

CERTAIN FACTORS WERE ASSOCIATED WITH

THEIR PERSISTENCE IN CHEMISTRY

Percentages for non-persistors are given in parentheses.

1.	Friendly and helpful attitudes on the part of chemistry professors toward their students	66%	(4%)
2.	Training of chemistry professors in teaching	49%	(0%)
3.	Training of chemistry professors in chemistry	48%	(0%)
4.	Abilities of chemistry professors to inspire students	48%	(4%)
5.	Parental advisement and encouragement to continue with a major in chemistry	24%	(0%
6.	Adequacy of advisement for chemistry students after selection of chemistry as their major	20%	(4%)
7.	Economic status of students	7%	(4%)
8.	General intelligence of students	7%	(0%)
9.	Attitudes of chemistry storeroom employees toward students	4%	(0%)
10.	Adequacy of equipment in college chemistry laboratories	3%	(0%)
11.	Moderate size of laboratory classes in chemistry, especially during the freshman year	3%	(21%)

12.	Abilities of professors to gear instruction in the theory of general chemistry to the level of the beginning student	3%	(0%)
13.	Abilities of students to express their thoughts both orally and in writing	3%	(0%)
14.	Condition of buildings housing chemistry laboratories	2%	(0%)
15.	Necessity of spending three hours in chemistry laboratory work per week for one semester-hour credit	2%	(17%)
16.	Safety records in college chemistry laboratories	2%	(0%)
17.	Emphasis by college professors on the personal satisfactions and rewards from making a career of chemistry	2%	(0%)
18.	Abilities of chemistry laboratory instructors to speak and understand English well	2%	(0%)
19.	The degree to which brilliant chemistry students are challenged to do the best of which they are capable	2%	(0%)
20.	Emphasis on the cultural aspects in courses in general chemistry	2%	(0%)
21.	Reading abilities of students	2%	(0%)
22.	Scientific aptitudes of students	2%	(0%)
23.	The possibility of military service exemptions for those continuing in chemistry as an area of specialization	2%	(0%)
24.	Degree of students' physical handicaps	2%	(0%)
25.	Amount of outside preparation involved in the pursuit of chemistry as a major	2%	(0%)
26.	"Scuttlebutt" from other college students concerning the degree of difficulty of advanced chemistry courses to be taken by chemistry majors	2%	(0%)

Non-persistors gave a number of factors which persistors did not (0%). These are listed below with percentages of non-persistors given in parentheses.

1.	Lack of mathematical ability	0%	(25%)
2.	Experiences in military service after declaring major in chemistry, which resulted in change of major	0%	(13%)
3.	Changed to a more "desirable" major, such as pre-med., vet.-medicine	0%	(8%)
4.	Peer influence to change	0%	(8%)
5.	Sex of students	0%	(4%)
6.	Abilities of chemistry lecturers to use readily understood English	0%	(4%)
7.	Attitude of professors toward store-room employees majoring in chemistry	0%	(4%)
8.	Couldn't get physics	0%	(4%)
9.	Wanted to be own boss	0%	(4%)
10.	Arts and Sciences personnel aloof	0%	(4%)
11.	Wanted outdoor work	0%	(4%)
12.	Wanted to major in mathematics in the first place	0%	(4%)
13.	Couldn't make up mind what he wanted to do	0%	(4%)
14.	Lazy - didn't try	0%	(4%)
15.	Marriage interfered with completing degree for ten years	0%	(4%)
16.	Summer chemistry work routine - lost interest	0%	(4%)

VITA

Willis Ivan Decker

Candidate for the degree of

Doctor of Education

Thesis: FACTORS ASSOCIATED WITH SELECTION OF AND PERSISTENCE IN CHEMISTRY AS AN AREA OF SPECIALIZATION BY OKLAHOMA STATE UNIVERSITY UNDERGRADUATES

Major Field: Chemical Education

Biographical:

Personal data: Born near Crescent, Oklahoma, August 26, 1911, the son of Charles E. and Lilice Bertha Decker.

Education: Attended grade school in Crescent, Oklahoma; graduated from Crescent High School in 1929; received the Bachelor of Science degree from Oklahoma State University, with a major in chemistry, in May, 1933; received the Master of Science degree from Oklahoma State University, with a major in chemistry in May, 1936; completed requirements for the Doctor of Education degree in 1959.

Professional experience: Taught science and mathematics in junior high and high school in Dewey, Oklahoma during 1934 to 1937. Was head of the department of chemistry and biological sciences at Eastern Oklahoma A. and M. College, Wilburton, from 1937 to 1942. Worked as chemist for E. I. duPont de Nemours and Company during 1942 to 1945. Since 1945, except for leave of absence during 1954 to 1956, have been head of the department of chemistry at East Central State College, Ada, Oklahoma. Was graduate-assistant at Oklahoma State University 1954-55.

Professional organizations: American Chemical Society, Chemical Education Division of the American Chemical Society, Phi Lambda Upsilon, Phi Kappa Phi, Phi Delta Kappa, National Education Association, Oklahoma Education Association.

Typist: E. Grace Peebles